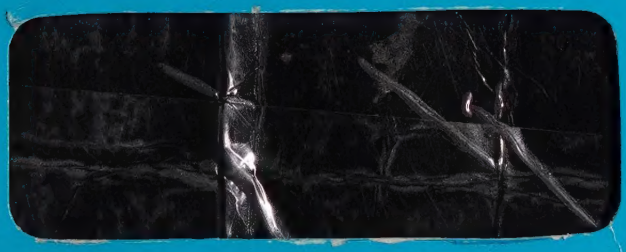
Do NOT LOAN OUT

EML USE ONLY

Operating Instructions



GOULD

GOULD BRUSH

MANUAL PART NO.
802607-10

MARK 240 RECORDER

PRINTED 6-14-71
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Gould Inc., Brush Division
3631 Perkins Avenue-Cleveland, Ohio 44114

9TH PRINTING
PRINTED IN U.S.A.

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Para. 7 show on
Fig 2 where cap is ~~for~~
located.

para. 11
~~One for each~~
One for each channel.
turn time on
5mm/sec ÷ 100.

---

disregard para 13

40mm only

R32

para 1. remove all
plug-in preamp;
make CONNECTIONS to
pre. amp connectors

---

final
Recheck span
adj. with amp. inserted
into mainframe.

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Section I
General Information

MARK 240 RECORDER

1.1 INTRODUCTION

a. General

The Brush Mark 240 Recorder, Model 0000-6607-10 (Fig. 1-1) is a versatile, highly accurate, self-contained system designed for a wide range of applications where resolution and precision in measurement are required.

The modular design permits selection of interchangeable 4200 series plug-in preamplifiers affording choice of high gain D.C. units (with or without calibrated zero suppression), straight thru couplers, and strain-gage and demodulator types.

Penmotor amplifier modules provide choice of two each of dual-channel 40 mm or single-channel 80 mm analog penmotors, or 8-channel event multimarker penmotor--either alike or in combinations. The analog modules include drive amplifiers mounted internally, providing required sensitivity for preamplifier inputs, position-feedback-circuitry, signal-limited circuitry, and controls for damping and span adjust. Multimarker event amplifiers, also internally mounted, provide 5 volts ON, and 0 to 4 volts OFF triggering and 100 K impedance for multimarkers. Maximum recording linearity is achieved with the above analog penmotors which utilize the proprietary Brush Metrisite transducer for instantaneous closed-loop pen position feedback control.

The writing system employs pressurized fluid to produce uniform, clear, rectilinear traces on low-cost chart paper. Twelve chart speeds, from 0.05 millimeters per second to 200 millimeters

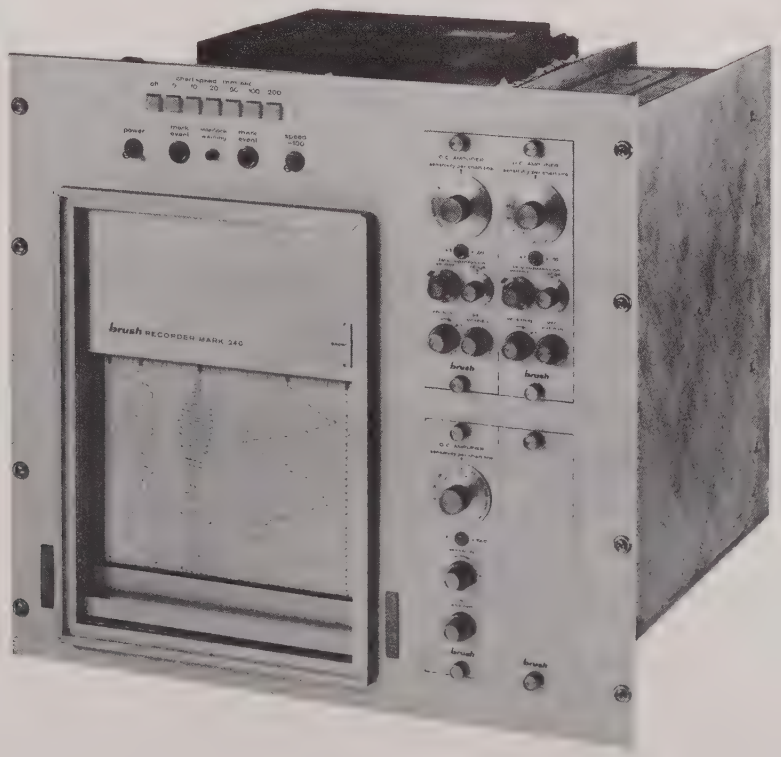

Figure 1-1 Mark 240 Recorder

per second, are selected by illuminated pushbuttons, and may be changed instantaneously without loss of data. Chart paper is easily loaded from the front and is delivered externally. External chart takeup is available as an accessory.

The recorder mounts vertically or horizontally in standard 19 inch racks, or in table-top carts or bench-top cabinets.

b. Model Numbering

The 0000 prefix is replaced by digits identifying penmotors and order of placement from left to right facing the unit:

1 - Single-pen 80 mm analog penmotor

2 - Dual-pen 40 mm analog penmotor

8 - 8-pen multimarker event penmotor

0 - No penmotor

1.2 SPECIFICATIONS

This paragraph describes the specifications and data pertinent to the Mark 240 Recorder.

NOTE: Refer to appropriate 4200 series preamplifier manual for signal-conditioning specifications.

No. Channels	40 mm - 4 analog, 2 event 80 mm - 2 analog, 2 event
Chart Speeds	12, electrically selected, two ranges; .05, .1, .2, .5, 1, 2, 5, 10, 20, 50, 100 and 200 mm/sec.
Chart Speed Accuracy	0.25% nominal line frequency
Chart Capacity	High contrast - 275 feet Reproducible - 400 feet
Writing method	Pressurized fluid (closed system) 2-oz capacity; approximately 50 rolls normal recording
Trace Width	0.01 inch nominal
Presentation	True rectilinear
Frequency Response	Refer to Figures 1-2 and 1-3.
Controls	Chart drive off and 6 chart speeds; speed ÷— 100; mark event button (2); power on-off; interlock indicator
Weight	170 pounds maximum (subject to module selection)
Dimensions	17-1/2 inches high, 19 inches wide, 20-1/2 inches deep
Power Requirements	115 volts 60 cps, 300 watts (maximum)

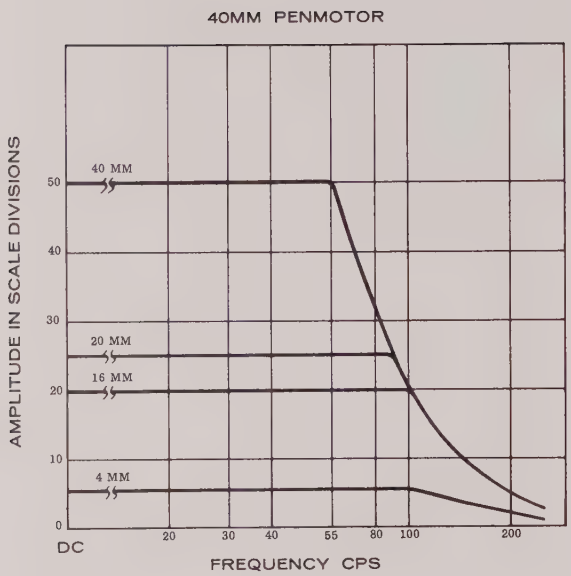

Figure 1-2 Frequency Response - 40mm Penmotor

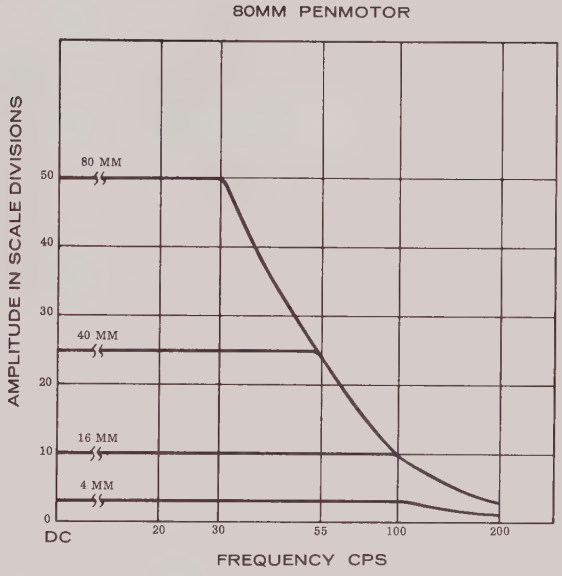

Figure 1-3 Frequency Response - 80mm Penmotor

1.3 SUPPLIES AND ACCESSORIES

The following is a list of supplies and accessories available for the recorder.

RA-2821-20	Event Marker Pen 20-25 grams
RA-2823-32	Analog Pen 28-32 grams
11-2732-02	Ink, blue, 2-oz
11-2923-20	Chart paper, high gloss, coated stock, 2-80 mm channels, 50 divisions per channel, 275 feet
11-2923-40	Chart paper, reproducible, 2-80 mm channels, 50 divisions per channel, 400 feet
1200-2923-20	Chart paper, high gloss coated stock, 1-80 mm and 2-40 mm channels, 50 divisions per channel, 275 feet
2200-2923-20	Chart paper, high gloss coated stock, 4-40 mm channels, 50 divisions per channel, 275 feet

240601-910	Gram Gage
1-120922-2	Wrench, Pen Pressure Adjustment
1-120922-18	Wrench, Pen Replacement
11-6402-02	External Chart Takeup
RA-2103-90	Interchannel Event Marker
RA-1201-10	Internal One Second Timer
341409-915	80 mm Penmotor Band Replacement Tool
341409-925	40 mm Penmotor Band Replacement Tool
11-6405-10	Mobile Cart
11-6404-24	Enclosure for cart mounting
11-6407-00	Cabinet for bench top operation

Section II
Installation

2.1 GENERAL

This section describes the checks and inspections that should be made upon receipt of the Brush Mark 240 Recorder. This section also contains installation instructions and outline dimensions, and provides installation procedures for the external chart takeup.

2.2 INCOMING INSPECTION

1. Visually inspect unit for damage that may have occurred during shipment.

2. Remove packing and tape from unit.

3. Remove sheet of chart paper from under pens and load chart paper supply roll into recorder.

4. Check ink supply.

5. Check for loose cable connections.

6. Be sure POWER switch is in OFF position.

7. Connect power input cable to correct power source.

NOTE: Power source to be 115 ± 10 volts 60 cps 300 watts (maximum).

8. Attach signal input cable to connectors on rear of preamplifiers.

CAUTION: Refer to the signal connection procedure in the preamplifier manual to make sure proper connections are made. Failure to do this can result in damage to the instrument.

9. Perform preliminary operation procedures (Para. 4.3).

2.3 INSTALLATION INSTRUCTIONS

Refer to drawing 662769 for installation instructions and wiring diagram 262109 for signal connections.

2.4 OUTLINE DIMENSIONS

Refer to drawing 462793 and 461119.

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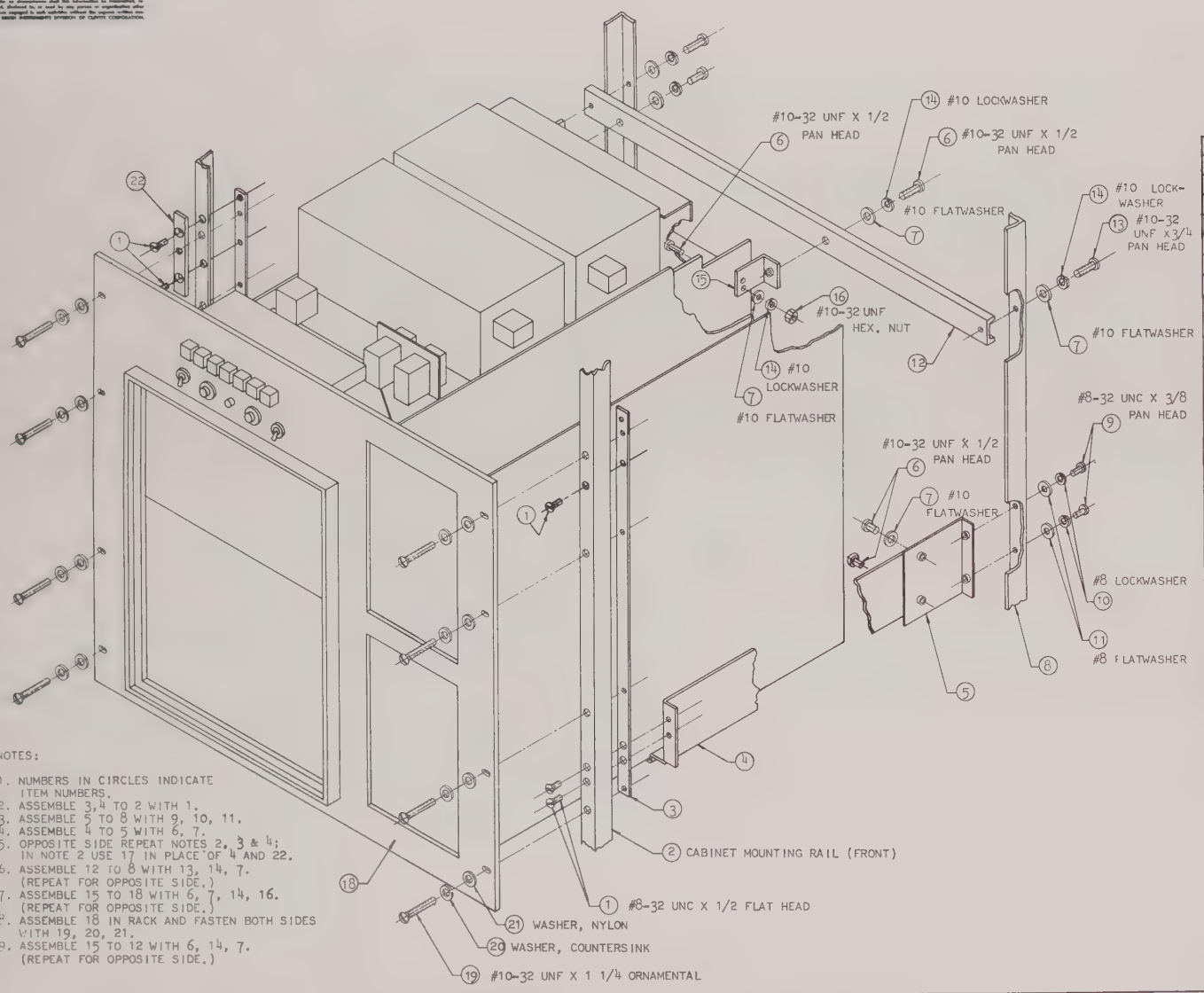
REV. E-1



NOTES:

1. NUMBERS IN CIRCLES INDICATE ITEM NUMBERS.
2. ASSEMBLE 3,4 TO 2 WITH 1.
3. ASSEMBLE 5 TO 8 WITH 9, 10, 11.
4. ASSEMBLE 4 TO 5 WITH 6, 7.
5. OPPOSITE SIDE REPEAT NOTES 2, 3 & 4; IN NOTE 2 USE 17 IN PLACE OF 4 AND 22.
6. ASSEMBLE 12 TO 8 WITH 13, 14, 7. (REPEAT FOR OPPOSITE SIDE.)
7. ASSEMBLE 15 TO 18 WITH 6, 7, 14, 16. (REPEAT FOR OPPOSITE SIDE.)
8. ASSEMBLE 18 IN RACK AND FASTEN BOTH SIDES WITH 19, 20, 21.
9. ASSEMBLE 15 TO 12 WITH 6, 14, 7. (REPEAT FOR OPPOSITE SIDE.)

NO.	BRUSH PART NO.	DESCRIPTION	QUAN
37			
36	115799-48	ABRASIVE	X
35	141119	SHEET, ABRASIVE	6
34	1-120922-18	WRENCH	1
33	1-120922-2	WRENCH	1
32	222641	CARD, WARRANTY	1
31	222640	CARD, CONCEALED DAMAGE	1
30	231977-910	CONNECTOR ASM	4
29	422642	ENVELOPE, INST. MANUAL	1
28	330000-237	MANUAL, INSTRUCTION	1
27			
26	240601-910	GAGE ASM., GRAM	1
25			
24			
23			
22	249050	SHIM, FRONT PANEL	1
21	126138-9	WASHER, NYLON	8
20	31-120650-10	WASHER, COUNTER SINK	8
19	31-121534-0220	SCREW, ORNAMENTAL	8
18	0000-6607-10	RECORDER MK. 240	1
17	662744	HANGER ASM., SUPPORT LH	1
16	31-119998-02	NUT, HEX. HEAD	2
15	662773	ANGLE ASM., SHIPPING	2
14	1-216741-430	WASHER, SPRING	6
13	31-119918-0212	SCREW, PAN HEAD	2
12	348610	TIE BAR, SHIPPING	1
11	1-118195-307	WASHER, PLAIN	4
10	1-216741-425	WASHER, SPRING	4
9	31-119918-8206	SCREW, PAN HEAD	4
8	CABINET	19 " RETMA	-
7	1-118195-309	WASHER, PLAIN	8
6	31-119918-0208	SCREW, PAN HEAD	8
5	643753-10	BRACKET ASM., SUPPORT	2
4	662745	HANGER ASM., SUPPORT RH	1
3	362746	NUT PLATE, FRONT PANEL	2
2	CABINET	19 " RETMA	-
1	31-119920-8208	SCREW, FLAT HEAD	6

SHIPPING LIST

BY	DATE	NAME
DR. WBS/GB		SHIPPING LIST AND INSTALLATION INSTRUCTIONS
CH.		CODE IDENT. / ISSUE CODE: G
APP. J.A. Hook 9/6		

BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND, OHIO, U.S.A.

DWG NO. 662769

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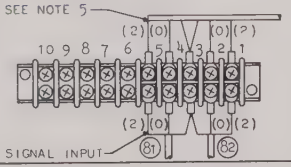
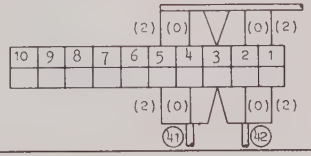
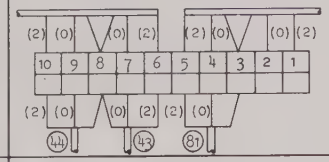
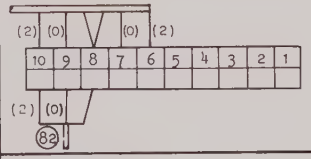
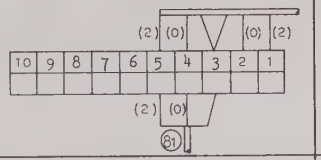
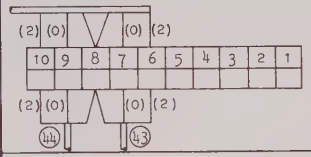
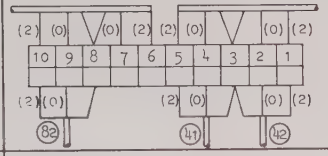
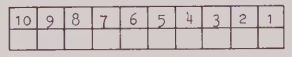
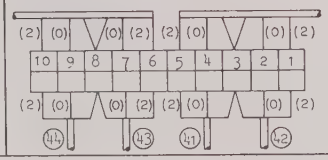
REV. A-1

MODEL NUMBER	WIRING OF TB-104 FOR SIGNAL INPUT TO THE DRIVE AMPLIFIER OF 0000-6607-00	NUMBER OF ANALOG CH.	MODEL NUMBER	WIRING OF TB-104 FOR SIGNAL INPUT TO THE DRIVE AMPLIFIER OF 0000-6607-00	NUMBER OF ANALOG CH.
1100-6607-00		2	2800-6607-00		2
1200-6607-00		3	8100-6607-00		1
1800-6607-00		1	8200-6607-00		2
2100-6607-00		3	8800-6607-00	 NO CONNECTIONS ARE REQUIRED FOR THIS CONFIGURATION.	0
2200-6607-00		4			

5. INTERNAL SIGNAL CABLE TO DRIVE AMPLIFIER FOR 80 MM OR 40 MM PEN MOTOR: SEE WIRING DIAGRAM:
   A. 262018 FOR 80 MM PEN MOTOR.
   B. 262090 FOR 40 MM PEN MOTOR.
   C. CONNECTIONS FOR SIGNAL INPUT TO MULTI-MARKER DRIVE AMPLIFIER ARE LOCATED ON DRIVE AMPLIFIER CHASSIS. TB-104 IS NOT REQUIRED FOR SIGNAL CONNECTION. (SEE SCHEMATIC 446263).

4. WIRE COLORS IN E.I.A. CODE ARE SHOWN IN PARENTHESES ( ).

3. SHIELDS ARE CONNECTED TO TB-104-3 OR 8.

2. THE NUMBERS WHICH ARE ENCIRCLED CORRESPOND TO THE CHANNEL IDENTIFICATION STRIP USED TO LABLE EACH ANALOG ON THE FRONT OF UNIT.

1 A POSITIVE SIGNAL APPLIED TO THE RED LEAD (2) WITH RESPECT TO THE BLACK LEAD (0) WILL DEFLECT THE CORRESPONDING ANALOG PEN TO THE RIGHT (AS VIEWED FROM FRONT OF UNIT).

NOTES:

	BY	DATE
DR	Springer	6/24/66
CH	BBS	6/5/66
APP		

NAME: DIAGRAM, WIRING
MODEL NO. 0000-6607-00
CODE IDENT | ISSUE CODE G

BRUSH INSTRUMENTS
DIVISION OF CLEVITE CORP.
CLEVELAND OHIO U.S.A.

DWG NO. 262109
SHEET 1 OF 2

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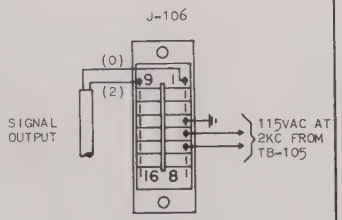
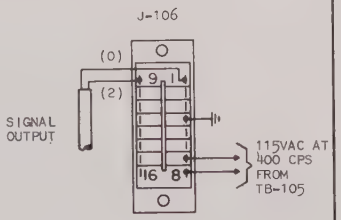
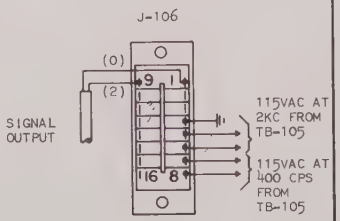
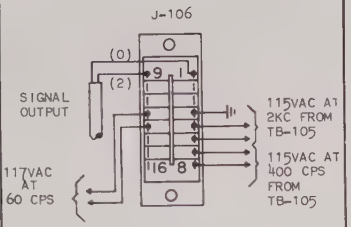
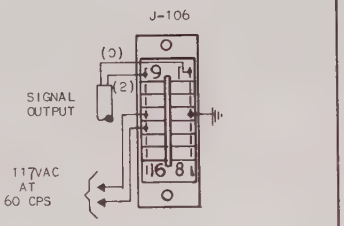
REV. A-1

13-4212-XX	13-4215-XX	13-4216-XX
		 (13-4216-XX WILL FUNCTION ON EITHER 400 CPS OR 2KC, BUT 2KC IS PREFERRED).
13-4211-20	**11-5201-XX**	
 (13-4211-20 WILL FUNCTION EQUALLY WELL ON 60 CYCLE, 400 CYCLE OR 2KC)		

5. LABELS 349232 WITH THE PROPER DASH NUMBER WILL BE USED TO IDENTIFY THE PREAMPS, IN RESPECT TO THE ANALOG PENS WHICH THEY CONTROL (SEE MI-40176 FOR PROPER METHOD OF APPLYING LABELS).

4. WHEN SALES ORDER DOES NOT DEFINE LOCATION OF PREAMP, THE FOLLOWING RULES APPLY (AS VIEWED FROM FRONT OF UNIT).

   A. ANALOG PENS FROM LEFT TO RIGHT WILL BE CONTROLLED BY RESPECTIVE PREAMP. POSITIONS, FROM LEFT TO RIGHT, TOP TO BOTTOM.

2. SEE RESPECTIVE PREAMPLIFIER FOR SIGNAL INPUT CONNECTIONS.

1. ALL WIRE COLORS IN EIA CODE ARE SHOWN IN PARENTHESES ( ).

NOTES:

BY	DATE	NAME	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND OHIO, U.S.A.
DR BBS/EH	7/6/60	DIAGRAM, WIRING	
CH BBS	7/6/60	MODEL 0000-6607-08	DRAWING NO. 262109
APP TAN	7/6/60	CODE IDENT. / ISSUE CODE G	SHEET 2 OF 2

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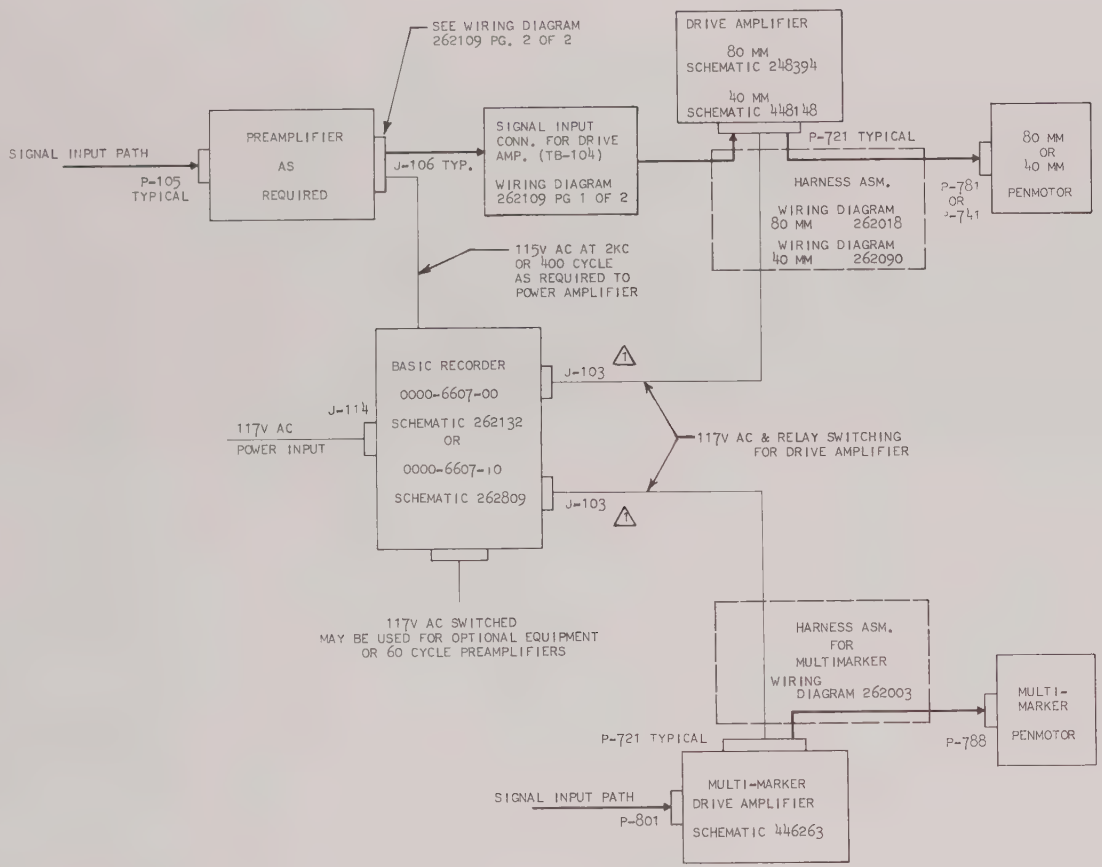
REV. A-1



⚠ DUE TO THE MODULAR SYSTEM, EACH HARNESS ASM. HAS A CONNECTOR CALLED J-103. INSIDE OF BASIC CHASSIS THERE ARE TWO CONNECTORS LABLED P-103A & P-103B, EITHER OF WHICH WILL MATE WITH J-103.

NOTES:

"BBS/EH 4/29/65	NAME BLOCK DIAGRAM (SCHEMATIC) MODEL 0000-6607-00	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP CLEVELAND OHIO U.S.A.
BBS 7/1/66	CODE IDENT	SIZE D	DWG NO 262186
A Novak 8/60			

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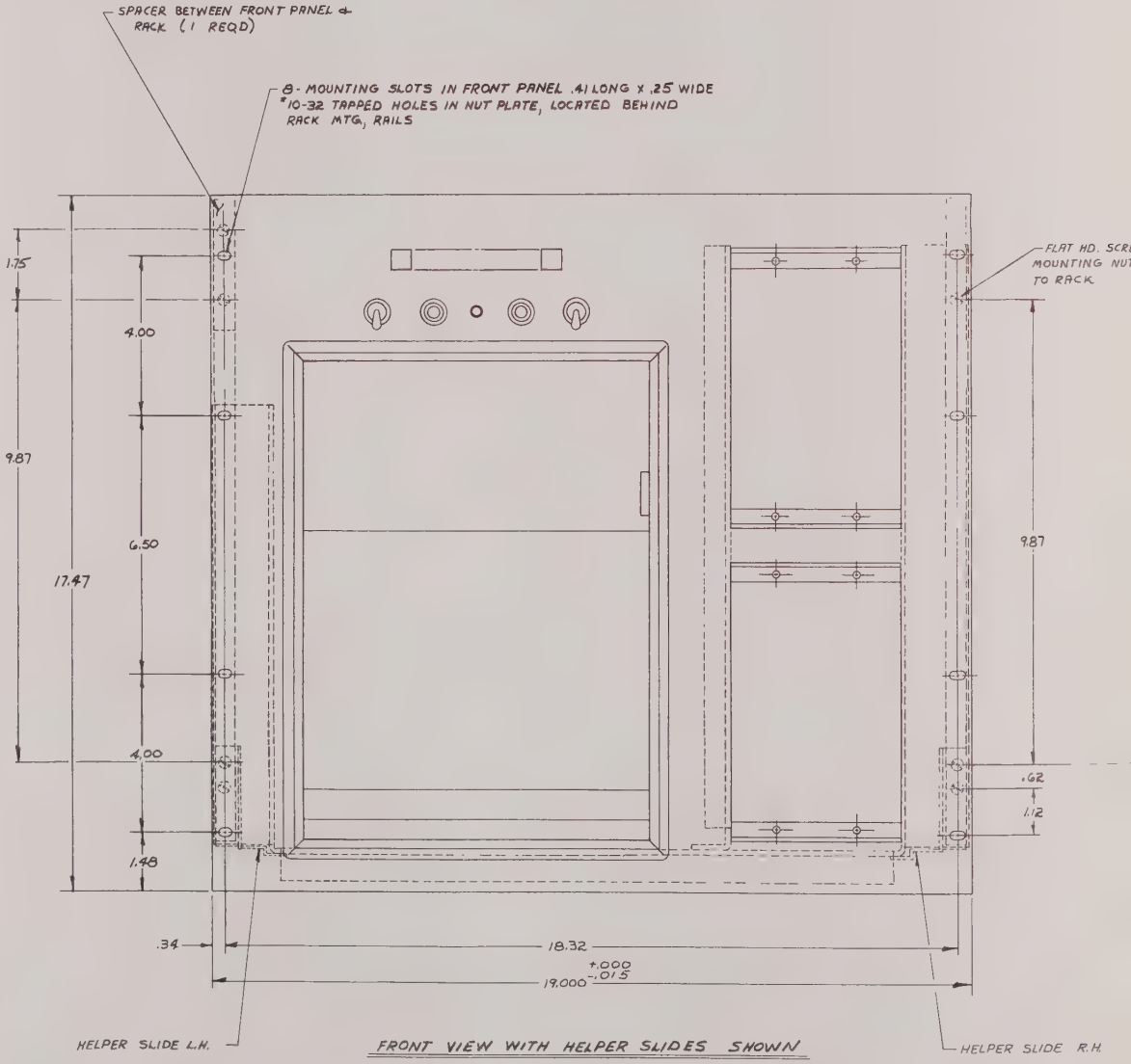
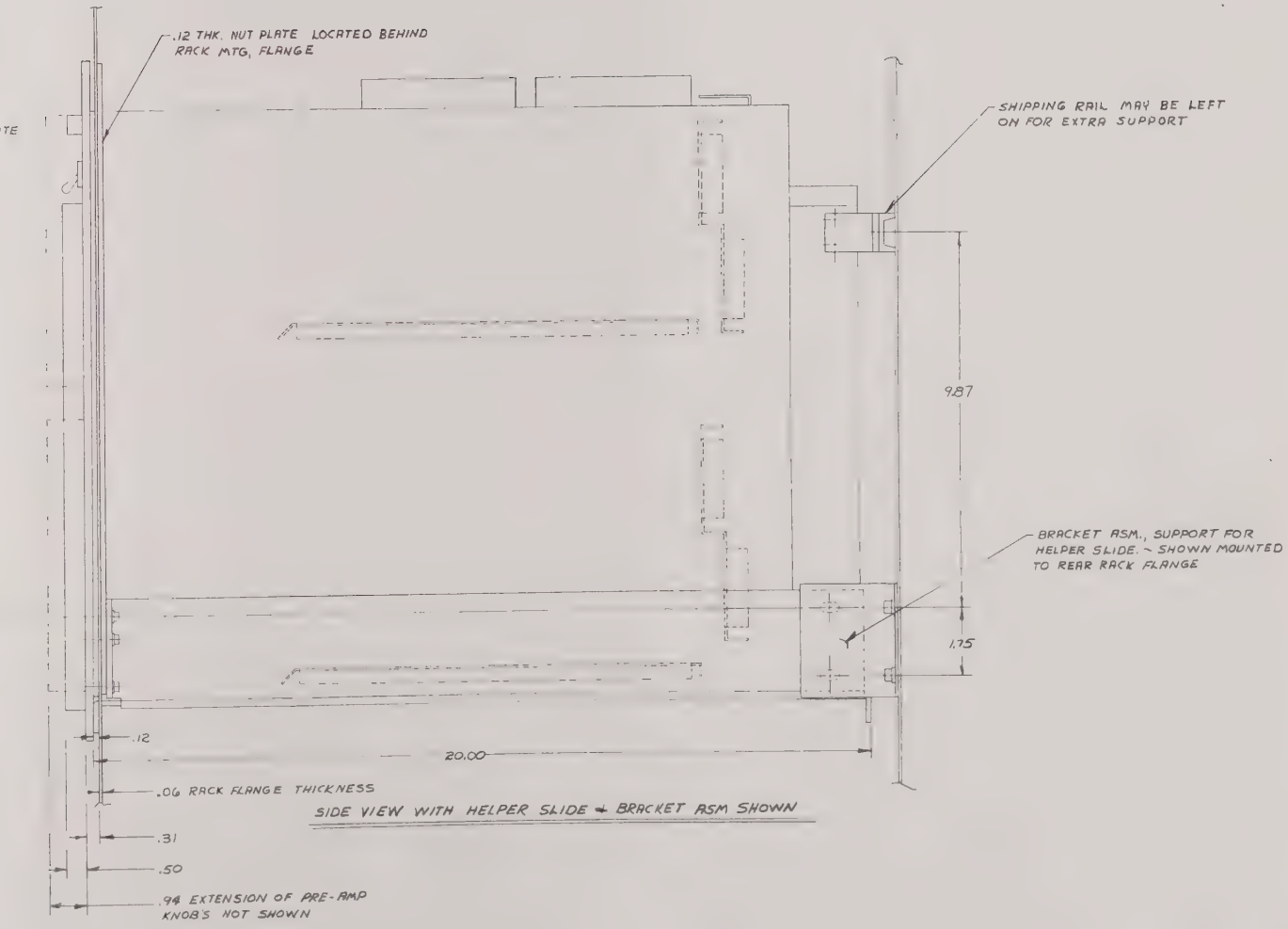


FRONT VIEW WITH HELPER SLIDES SHOWN

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL


.12 THK. NUT PLATE LOCATED BEHIND RACK MTG. FLANGE
SHIPPING RAIL MAY BE LEFT ON FOR EXTRA SUPPORT
9.87
BRACKET ASM., SUPPORT FOR HELPER SLIDE. - SHOWN MOUNTED TO REAR RACK FLANGE
1.75
20.00
.12
.06 RACK FLANGE THICKNESS
.31
.50
.94 EXTENSION OF PRE-AMP KNOB'S NOT SHOWN

SIDE VIEW WITH HELPER SLIDE & BRACKET ASM SHOWN

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CML
			LIST OF MATERIAL		

CODE 0607-10	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES = ±½° .XX = ± .015 .XXX = ± .005 SURFACE = √	BY / DATE DR Spencer 9/22 CH APP J. A. Moench 9/22	NAME OUTLINE, DIMENSIONAL	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND OHIO U.S.A.	
	MATL ADD FIN		CODE IDENT 5	ISSUE CODE G	DWG. NO 462793
FIRST USE			SCALE 1/2		PAGE 1 OF 2

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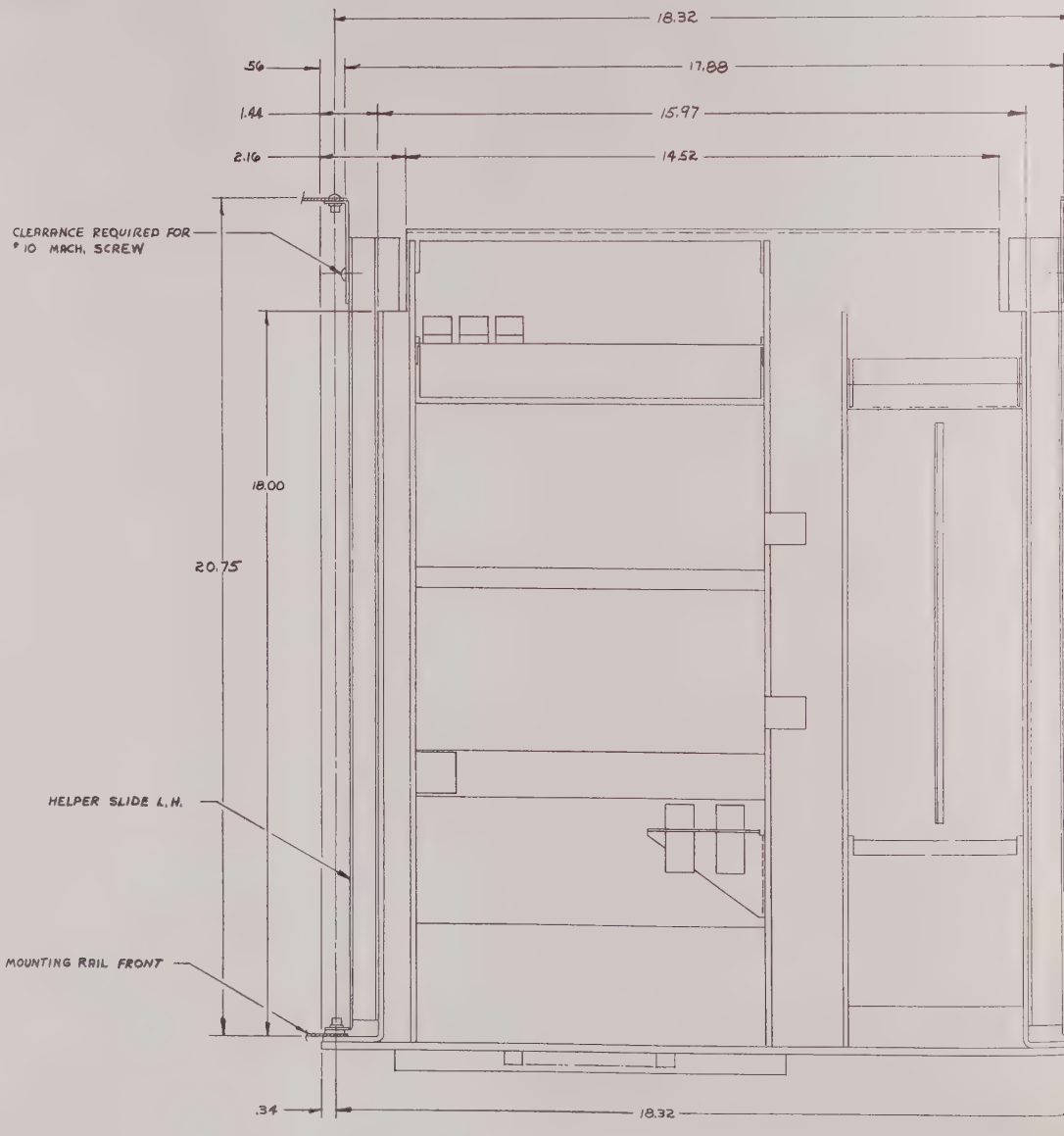
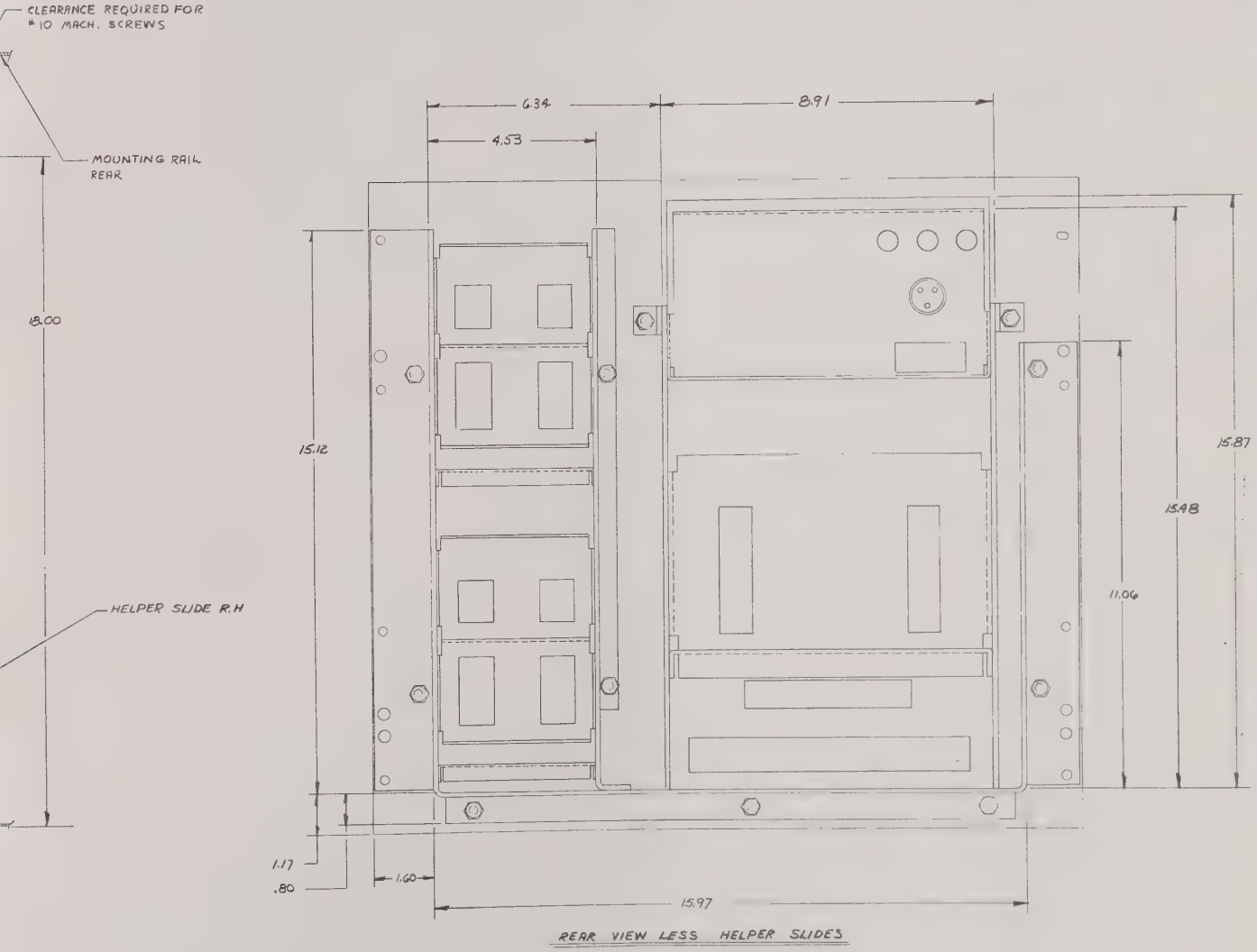


TOP VIEW WITH HELPER SLIDES + BRACKET ASM. SHOWN

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL



REAR VIEW LESS HELPER SLIDES

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CODE
			LIST OF MATERIAL		

0000 -6607 -10	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES = ± ½° .XX = ± .015 .XXX = ± .005 SURFACE = √	BY	DATE	NAME OUTLINE DIMENSIONAL	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP CLEVELAND OHIO U.S.A.
	MATL.	DR Springer	9/23/65		
		CH.			
	ADD FIN.	APP. J A Mouth	9/23/65		
FIRST USE				CODE IDENT. 55795 ISSUE CODE C SCALE 1/2	DWG. NO. 462793 PAGE 2 OF 2

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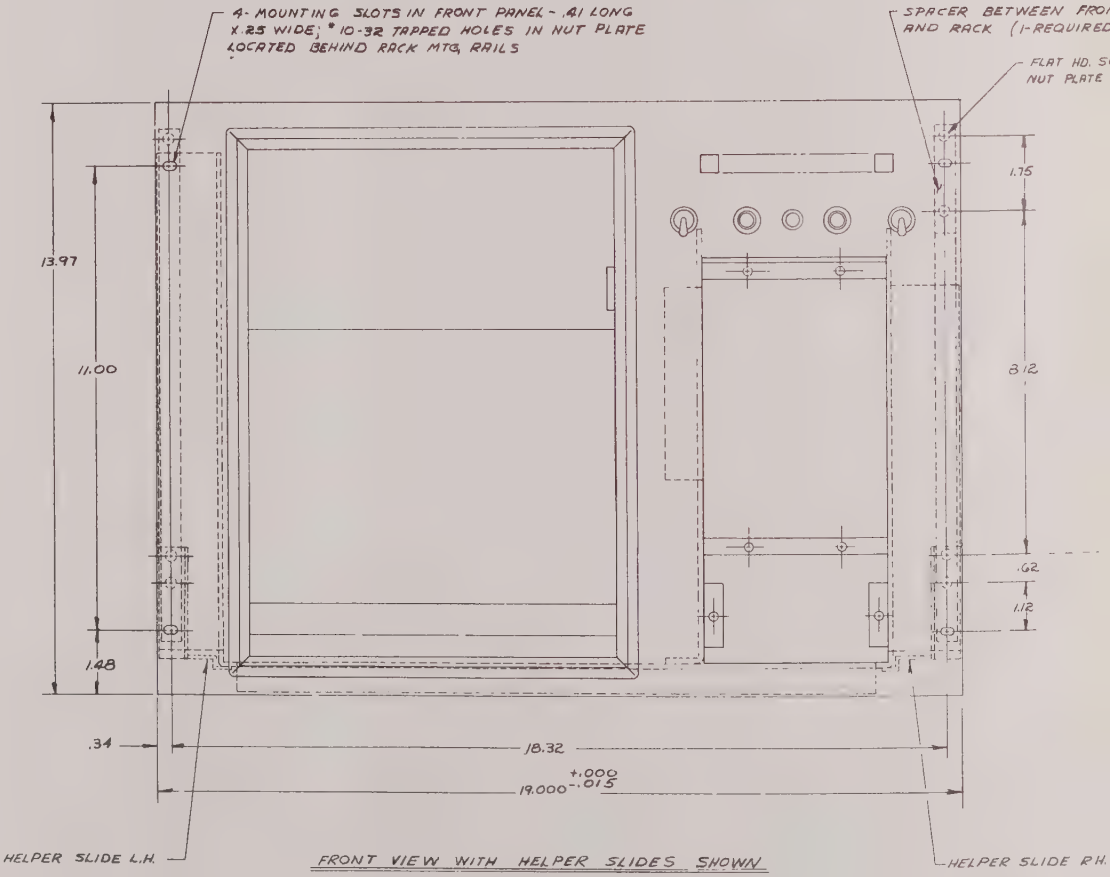
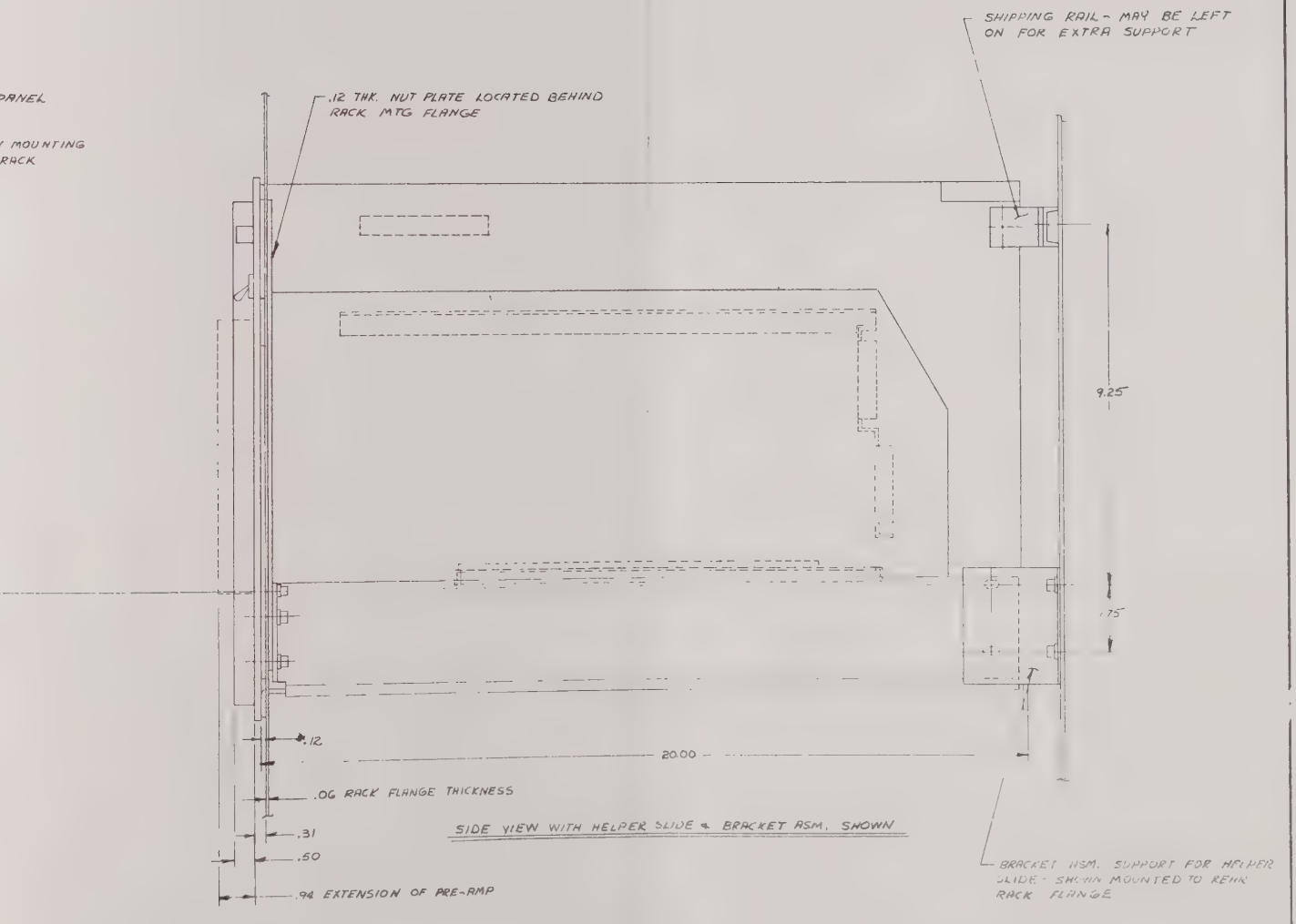


FRONT VIEW WITH HELPER SLIDES SHOWN

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
B-1	REVISED & REDRAWN PER DCN 5664 AMES	7/1/65	J.A.M.


SHIPPING RAIL - MAY BE LEFT ON FOR EXTRA SUPPORT
.12 THK. NUT PLATE LOCATED BEHIND RACK MTG FLANGE
9.25
.75
.12
20.00
.06 RACK FLANGE THICKNESS
.31
.50
.94 EXTENSION OF PRE-AMP
BRACKET ASM. SUPPORT FOR HELPER SLIDE - SHOWN MOUNTED TO REAR RACK FLANGE

SIDE VIEW WITH HELPER SLIDE & BRACKET ASM. SHOWN

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CHL

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ANGLES = ± ½°
.XX = ± .015
.XXX = ± .005 SURFACE = √
MATL.
ADD FIN.
FIRST USE

	BY	DATE
DR.	[illegible]	7/1/65
CH.	[illegible]	7/1/65
APP.	J.A.M.	7/1/65

NAME: OUTLINE, DIMENSIONAL

BRUSH INSTRUMENTS
DIVISION OF CLEVITE CORP.
CLEVELAND, OHIO, U.S.A.

CODE IDENT.
ISSUE CODE G
SCALE NONE
DWG. NO. 461119

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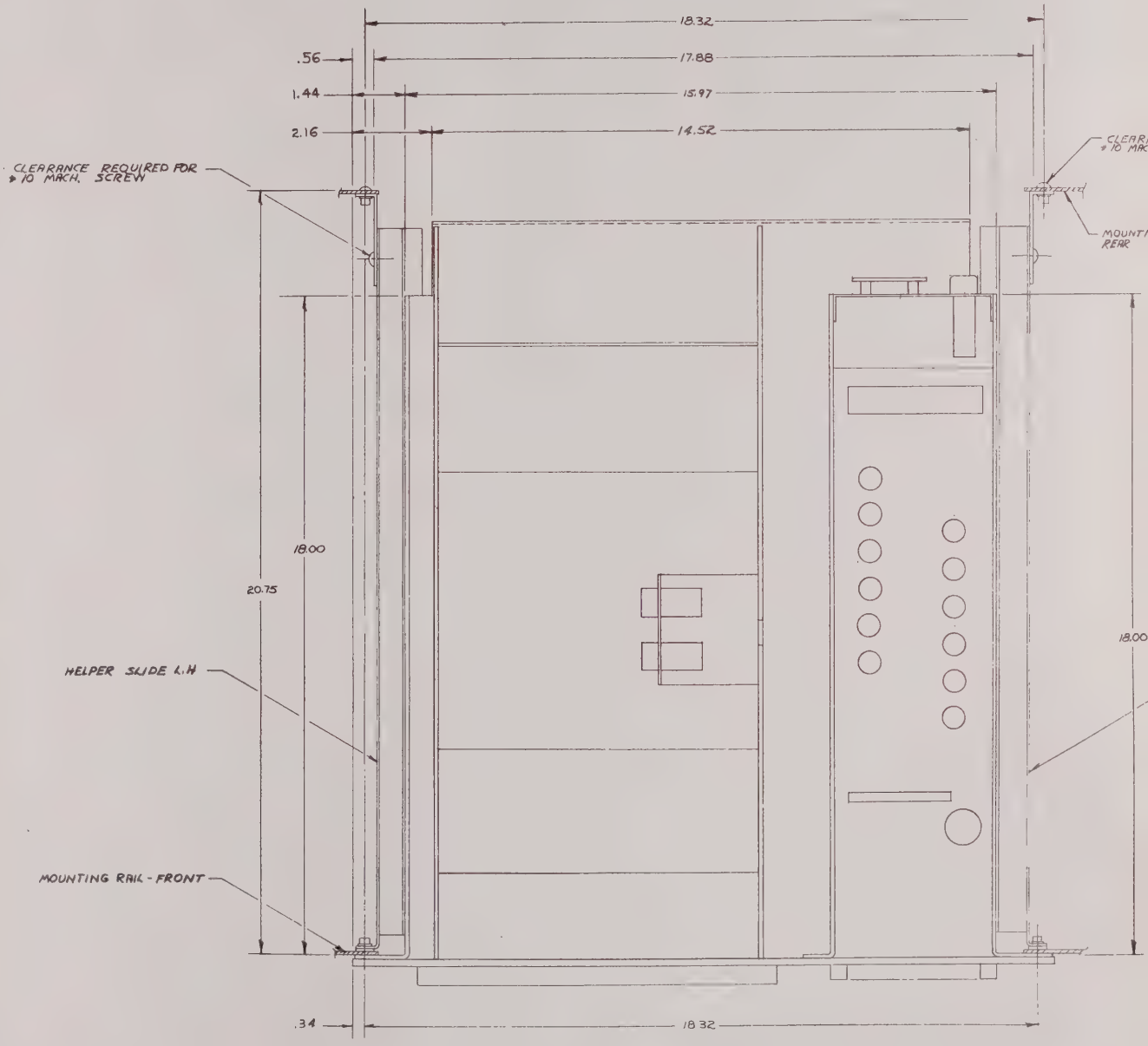
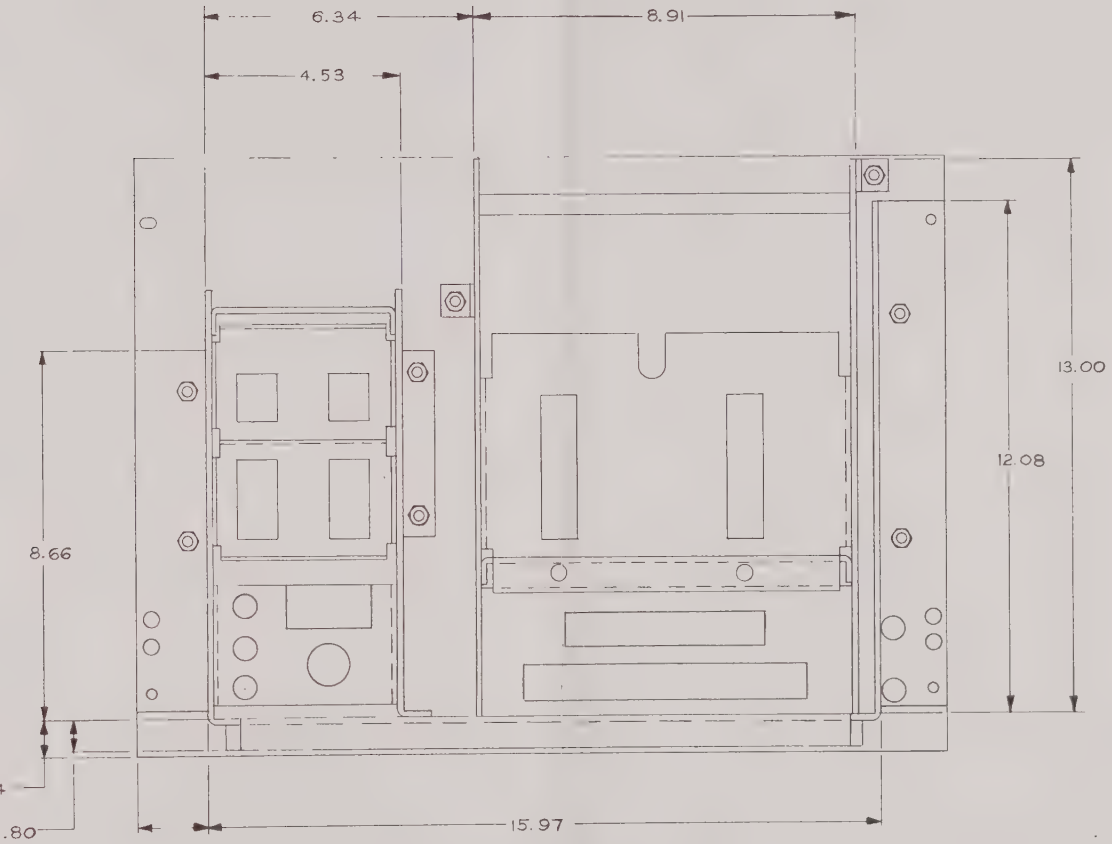


TOP VIEW WITH HELPER SLIDES & BRACKET ASM. SHOWN

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL

E REQUIRED FOR SCREW

RRIK



REAR VIEW LESS HELPER SLIDES

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CHL
			LIST OF MATERIAL		

0000 -6607 -00	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES = ± ½° .XX = ± .015 .XXX = ± .005 SURFACE = √	BY	DATE	NAME OUTLINE DIMENSIONAL	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND, OHIO, U. S. A.
		DR. A. AMES	11/11/65		
		CH.			
		APP.			
	MATL.			CODE IDENT. / ISSUE CODE G	DWG. NO. 461119
FIRST USE	ADD FIN.			SCALE NONE	SHEET 2 OF 2

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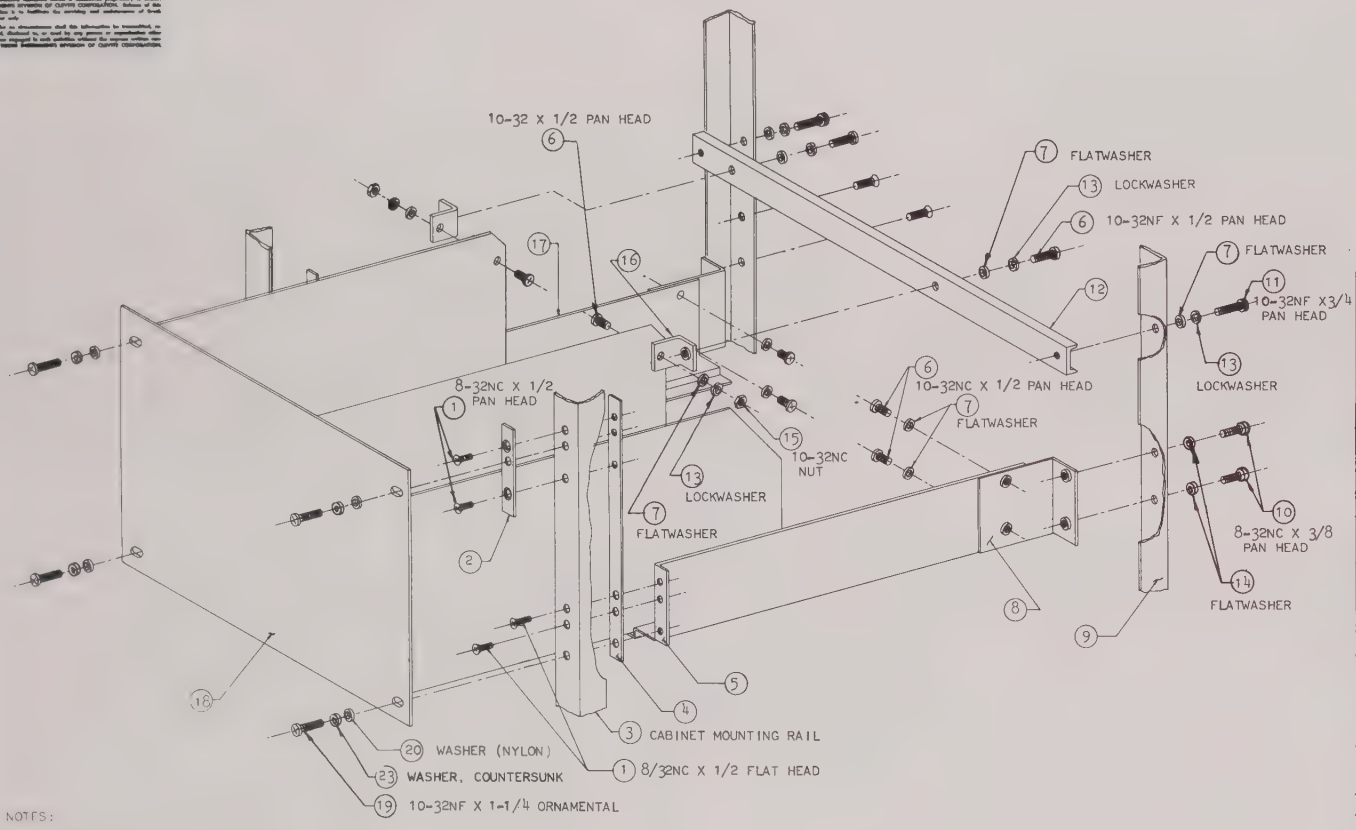
REV. A-1



NOTES:

1. NUMBERS IN CIRCLES INDICATE ITEM NUMBERS.
2. ASSEMBLE 2,4,5 TO 3 WITH 1.
3. ASSEMBLE 8 TO 9 WITH 10, 14.
4. ASSEMBLE 8 TO 5 WITH 6 AND 7.
5. OPPOSITE SIDE REPEAT NOTES 1, 2 AND 3 USING 17 IN PLACE OF 5. (NOTE THERE IS NO SHIM ON THIS SIDE).
6. ASSEMBLE 12 TO 9 USING 7,11 AND 13. (SAME FOR OPPOSITE SIDE.)
7. ASSEMBLE 16 TO 18 WITH 7,13 AND 15. (SAME FOR OPPOSITE SIDE.)
8. ASSEMBLE 18 IN CABINET AND FASTEN BOTH SIDES WITH 19 AND 20.
9. ASSEMBLE 16 TO 12 WITH 7,13 AND 14. (SAME FOR OPPOSITE SIDE.)

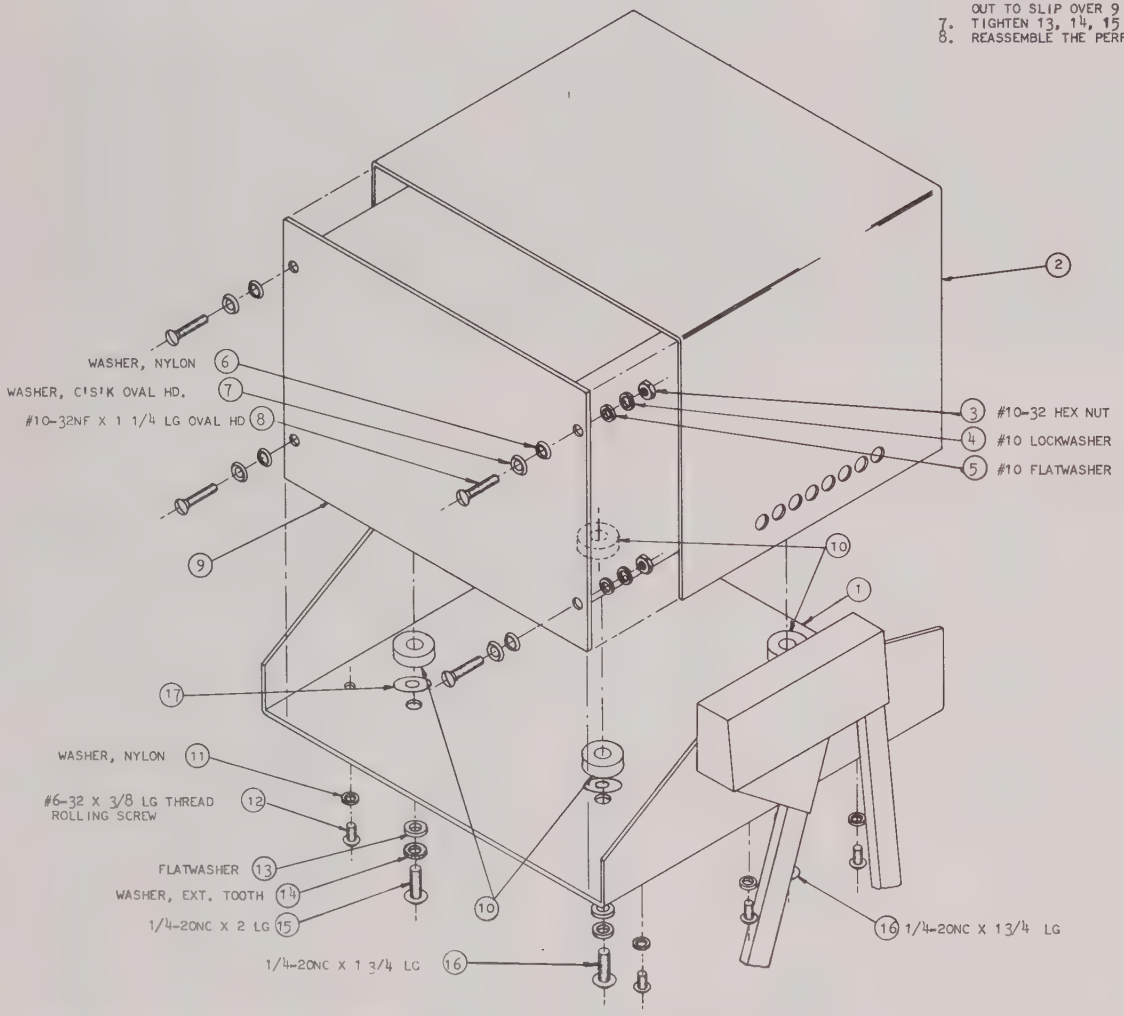
NO.	BRUSH PT. NO.	DESCRIPTION	QUAN
32	442642	ENVELOPE, INST. MANUAL	1
31	330000-230	MANUAL, INSTRUCTION	1
30	222641	CARD, WARRANTY	1
29	222640	CARD, CONCEALED DAMAGE	1
28			
27			
26			
25			
24	231977-910	CONNECTOR	2
23	31-120650-10	WASHER, COUNTERSUNK	4
22	126294	ADAPTER	1
21	240601-910	GAGE ASM, GRAM	1
20	126138-9	WASHER, NYLON	4
19	31-121534-0220	SCREW, ORNAMENTAL	4
18	0000-6607-00	RECORDER MARK 240	1
17	649048	HANGER ASM, SUPP. L.H.	1
16	648609	ANGLE ASM, SHIPPING	2
15	31-119998-02	NUT, HEX HEAD	2
14	1-118195-307	WASHER, F.L.	4
13	1-216741-430	WASHER, SPRING	6
12	348610	TIE BAR, SHIPPING	1
11	31-119918-0212	SCREW, PAN HEAD	2
10	31-119918-8206	SCREW, PAN HEAD	4
9	CABINET	19" RETMA	-
8	643753-10	BRACKET ASM, SUPPORT	2
7	1-118195-309	WASHER, PLAIN	10
6	31-119918-0208	SCREW, PAN HEAD	6
5	649049	HANGER ASM, SUPP. R.H.	1
4	348953	NUT PLATE, FRONT PANEL	2
3	CABINET	19" RETMA	-
2	249050	SHIM, FRONT PANEL TOP	1
1	31-119920-8208	SCREW, FLAT HEAD	8

SHIPPING LIST

BY	DATE		
VINCE/EH		SHIPPING LIST & INSTALLATION INSTRUCTIONS	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND, OHIO, U.S.A.
CH VLP	9/6/67	CODE IDENT.	DWG. NO. 662387
APP TAD	8/67	ISSUE CODE G	

NOTES:
1. ALL NUMBERS IN CIRCLES INDICATE ITEM NUMBERS.
2. ASSEMBLE 8 TO 9 USING 3, 4, 5, 6 AND 7.
3. PLACE 10 ONTO 1 SECURING IN PLACE WITH ITEM 17.
4. ASSEMBLE 9 TO 1 USING 13, 14, 15 AND 16. LEAVE SCREWS LOOSE.
5. REMOVE PERFORATED REAR SCREEN FROM 2.
6. ASSEMBLE 2 ONTO 1 USING 11 AND 12, SPRING COVER OUT TO SLIP OVER 9 TO KEEP FROM TEARING THE PAINT.
7. TIGHTEN 13, 14, 15 AND 16.
8. REASSEMBLE THE PERFORATED SCREEN.

REV. J-1



ITEM	BRUSH PART NO.	DESCRIPTION	QUAN
25			
24	267255	CARTON, PACKING	1
23	422642	ENVELOPE, INST. MANUAL	1
22	330000-245	INSTRUCTION MANUAL	1
21	222641	CARD, WARRANTY	1
20	222640	CARD, CONCEALED DAMAGE	1
19			
18			
17	266406	DISC SET, ADHESIVE	4
16	245204-4528	SCREW, TRUSS HEAD	2
15	245204-4532	SCREW, TRUSS HEAD	2
14	2-120053-106	LOCKWASHER, EXT TOOTH	4
13	3-118195-213	WASHER, FLAT	4
12	13-262716-6206	SCREW, PAN HEAD	6
11	243104-8	WASHER, NYLON	6
10	263361-2	SPACER	4
9	0000-6607-10	MARK 240	X
8	31-121534-0220	SCREW, OVAL HEAD	8
7	12-120650-10	WASHER, CSK OVAL HEAD	8
6	126138-9	WASHER, NYLON	8
5	1-118195-309	WASHER	8
4	1-216741-430	LOCKWASHER	8
3	31-119998-02	NUT, HEX	8
2	11-6404-24	DUST COVER	1
1	11-6405-10	CART	X

SHIPPING LIST

BY	DATE	NAME	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND OHIO U.S.A.
DR TG/EH	1/16/	SHIPPING LIST & INSTALLATION INSTRUCTIONS	
CK		CODE IDENT	ISSUE CODE G
APP			263400

Section III
Servicing

3.1 GENERAL

This section describes and illustrates servicing procedures that are considered routine when the Mark 240 Recorder is in operation. These procedures include loading or changing chart paper and replenishing ink supply.

3.2 CHART PAPER

a. Removal

1. Place POWER switch in the OFF position (Fig. 4-1).

2. Pull writing table to full open position (Fig. 3-1).

3. Hold supply roll and pull down on paper supply release lever (Fig. 3-1). Supply roll will drop free of table.

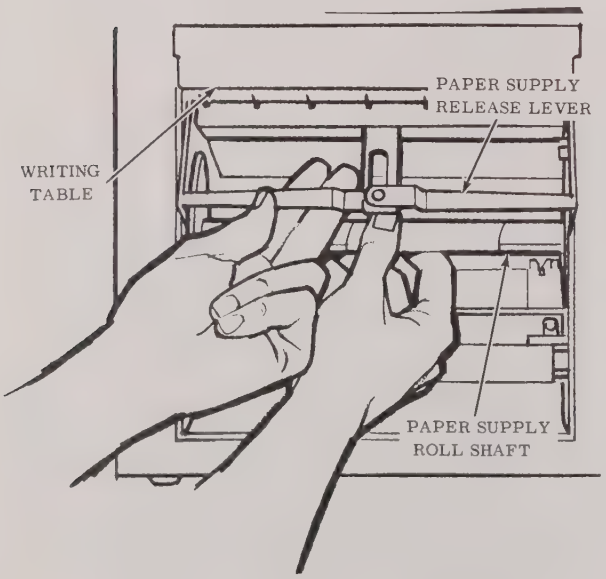


Figure 3-1 Remove Paper Supply Shaft

4. Unscrew hub assembly from supply roll shaft in a counterclockwise direction (Fig. 3-2).

5. Discard paper core.

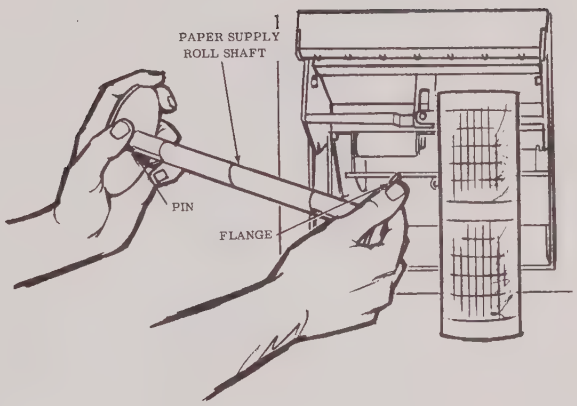


Figure 3-2 Remove Supply Roll Shaft Flange

b. Installation

1. Slide new paper supply onto supply roll shaft.

NOTE: Pins on shaft must engage notches in paper core.

2. Install hub assembly onto supply roll shaft and tighten hub.

NOTE: Hub should fit snugly against paper supply roll, but not tight enough to prevent paper from feeding off shaft.

3. Insert paper supply roll into writing table assembly and push paper supply release lever upward to lock paper supply roll in place (Fig. 3-3).

NOTE: Be sure paper supply roll shaft flanges are against stops to insure alignment of shaft with holes in writing table assembly.

4. Feed paper over writing bar, down writing table, and behind pressure roller as shown in Figure 3-4.

CAUTION: Load paper carefully to avoid damaging pens.

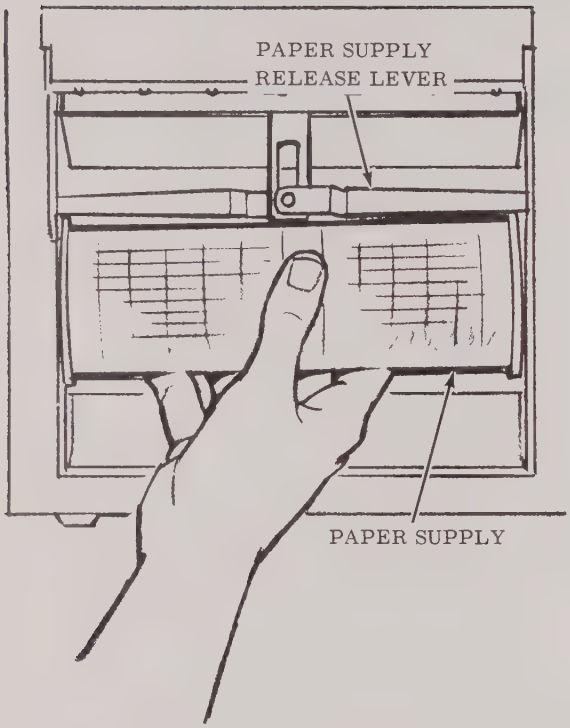


Figure 3-3 Insert Paper Supply Roll

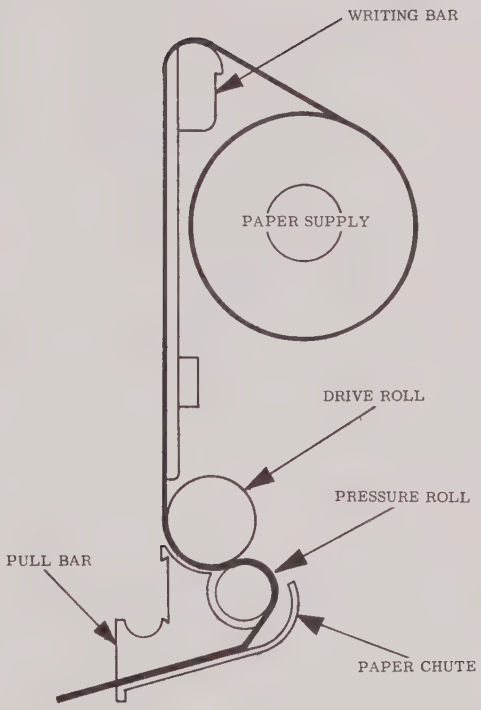


Figure 3-4 Paper Loading Diagram

5. Slowly close writing table assembly while pulling down gently on chart paper. When friction brake resists rotation of supply roll, pull paper taut, center on writing table and close writing table.

NOTE: This permits chart paper to lie flat against writing table and prevents paper lock beneath pressure roller.

6. Turn on recorder and run thru three feet of chart paper to stabilize chart.

NOTE: When using the external chart takeup, feed paper under and back over takeup bar. While holding paper in position, select a slow chart speed and allow paper to wind around bar.

3.3 INK SUPPLY

Normally a two ounce ink supply is sufficient for approximately 50 rolls of average recording. When it becomes necessary to add more ink, follow the procedure described below.

1. Turn POWER switch to OFF position.
2. Remove paper supply roll (Para. 3.2.a).
3. Unscrew cap from ink master cylinder.
4. Push paper supply release lever upward to facilitate filling.
5. Unscrew cap from master cylinder.
6. Remove cap from ink syringe.

NOTE: Make sure ink is to tip of syringe to prevent air from entering ink system.

7. Screw syringe tip into master cylinder in a clockwise direction.

8. Inject ink into cylinder until gage on master cylinder is at stop filling mark (Fig. 3-5).

CAUTION: Do not overfill pressurized inking system. This prevents inking system from returning to zero psi when unit is turned off.

9. Unscrew syringe from master cylinder.

10. Replace cap on master cylinder.

CAUTION: Make sure "0" ring seal is in place on cap.

11. Replace cap on ink syringe.

12. Pull paper supply release lever down to the release position.

13. Install chart paper supply roll (Para. 3.2.b).

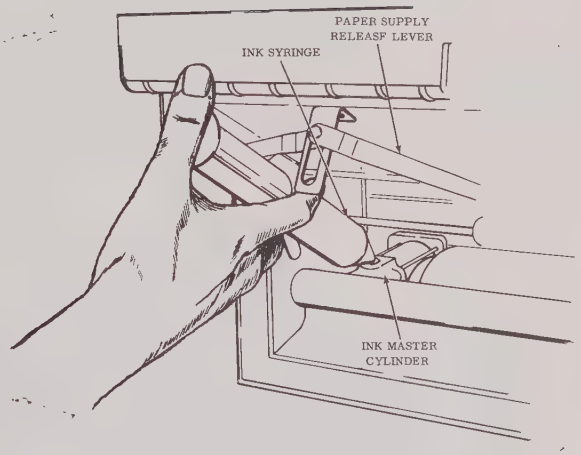


Figure 3-5 Filling Ink Master Cylinder

Section IV
Operation

4.1 GENERAL

This section describes and illustrates the controls of the Mark 240 Recorder and contains instructions for preliminary checks of the system prior to normal operation.

Refer to the appropriate 4200 series preamplifier manual for complete description of the preamplifier and instructions for its operation.

4.2 CONTROL DESCRIPTION

NOTE: The circled items in Figure 4-1 correspond with the items listed below.

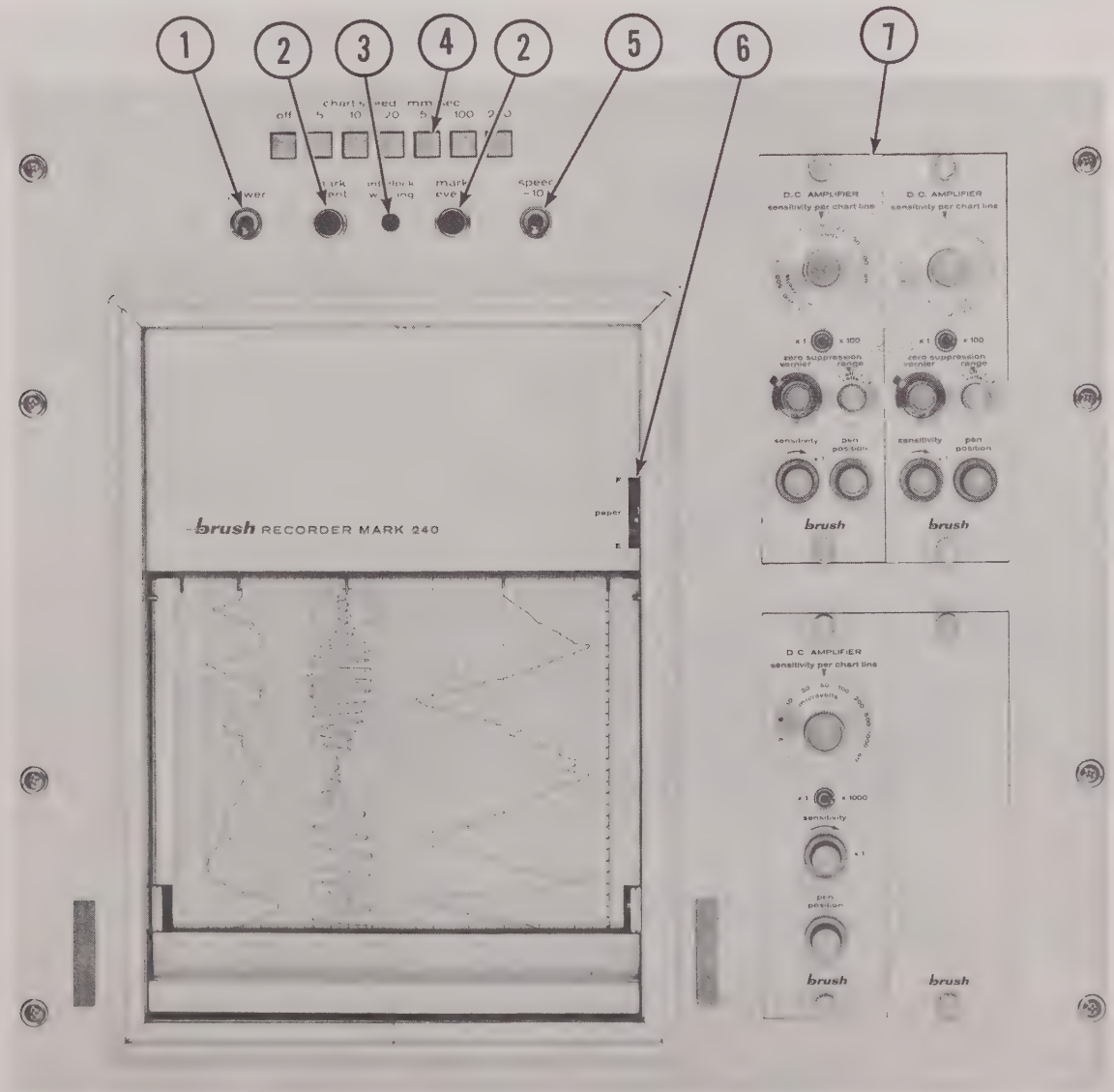


Figure 4-1 Control Description

1. Power Switch .....

This is a two-position toggle switch that controls power to the recorder from an A.C. power source. Power is ON when switch is in up position and OFF when switch is in down position.

2. Event Marker Button .....

Two buttons, one for each standard event marker. This momentary switch permits manual recording of an event. Normal pen deflection is to right.

3. Interlock Indicator .....

The interlock indicator is controlled by an interlock switch located in the recorder. When light is illuminated it indicates an open interlock switch due to an empty paper supply roll, or writing table not properly closed.

NOTE: Recorder will not operate when the indicator is illuminated.

4. Chart Speed mm/sec .....

The chart speed mm/sec is a seven position switch with the following functions:

a. Stop Button - Depressing STOP button stops chart drive operation and turns off power to pens.

b. Chart Speed Buttons - One for each speed, marked 5, 10, 20, 50, 100 and 200 mm/sec. Button depressed indicates chart drive speed.

NOTE: Depressing any chart speed button releases STOP button and turns on chart drive motor.

5. Speed ÷100 Switch .....

When this two-position toggle switch is in the up position the above chart speeds are divided by 100 and become .05, .1, .2, .5, 1 and 2 mm/sec. When switch is in the down position, chart speeds are as they appear on front panel.

6. Paper Supply Indicator .....

A mechanical indicator linked to a sensor that notes roll diameter. An interlock switch prevents the unit from operating when paper supply is exhausted.

7. 4200 Series Preamplifier .....

Refer to the appropriate preamplifier manual for control description and operating procedures.

4.3 PRELIMINARY OPERATION

NOTE: Be sure to read operating instructions in the preamplifier manual.

1. Be sure POWER switch is in off (down) position.

2. Press oscillograph chart speed OFF button.

3. Make sure power input cable is connected to a power source of 105-125 volts, A.C.

4. Make sure signal input leads are attached to preamplifier frame connectors at rear of unit.

CAUTION: Refer to the signal connection procedure in the preamplifier manual to make sure proper connections are made. Failure to do this can result in damage to the instrument.

5. Turn the preamplifier ATTENUATOR control to the OFF position.

6. Place the POWER switch in the on (up) position.

7. Place SPEED ÷100 switch in the up position and select a chart speed of 100 or 200 millimeters per second.

NOTE: This will move chart at one or two millimeters per second.

8. Loosen locking knobs on PEN POSITION controls.

9. Center pens with PEN POSITION controls located on preamplifiers.

10. Check to see that PEN POSITION control allows pen to traverse full chart width.

Unit is now ready for operation.

Section V
Theory of Operation

5.1 GENERAL

The Brush Mark 240 Recorder is a module-type solid-state system, consisting of preamplifier, drive amplifiers, and oscillograph. The recorder incorporates an effective servo-controlled position feedback system, high-torque penmotors, and pressurized fluid writing.

The penmotor drive amplifier is a complete servo-type system utilizing a Metrisite transducer in the penmotor to develop position and electronically derived velocity and acceleration signals. These signals are summed with an input signal in a D.C. error amplifier that supplies power for driving the oscillographic penmotor.

The penmotors connect electrical signals to the mechanical pen which records thru a balanced hydrostatic ink system on chart paper. The chart, which is contained in the oscillograph, is driven past the pens by an electrically actuated transmission.

5.2 DRIVE AMPLIFIER, 15-5221-11 and 15-5221-21

a. General

The drive amplifiers (Fig. 5-1) are dual-channel units designed to operate with the two position feedback penmotor mounted in the oscillograph.

b. Input Limiter

The input signal is applied to the input limiter transistors Q-501 and Q-502 thru protective diodes CR-501 thru CR-506. Maximum output voltage is limited by supply voltages at wipers of potentiometers R-6 and R-7 which are supplied with regulated + 5 and - 5 volts respectively. I_{CO} balance potentiometer allows for no current flow in the input when the input is shorted.

c. Demodulator

The full wave synchronous transistors Q-103, Q-104, Q-105 and Q-106 demodulate the 20 KC position feedback signal supplied by the Metrisite and deliver a D.C. position feedback signal to the A.C. amplifier and thru the gain control to the error amplifier.

d. A.C. Amplifier

The D.C. position feedback signal is passed thru R-106 CRS DAMP (acceleration) control and associated wave shaping networks to transistor Q-101 whose load resistor is the damping (velocity and acceleration) control. Transistor Q-102 supplies the velocity and acceleration currents, controlled by thermistor in penmotor, thru C-103 to the D.C. error amplifier. The input signal, velocity and acceleration, position feedback and D.C. feedback thru R-116 are summed at Q-107 to produce an error signal. This is paraphase coupled to Q-108 providing two polarities of error signal which are amplified by Q-109, Q-113, Q-114 and Q-110, Q-115, Q-120 respectively. Transistors Q-4, Q-5, Q-6 and Q-7 are in a bridge output configuration. These drive the oscillographic penmotor which connects the electrical output of the D.C. error amplifier to the mechanical motion of the pen.

Transistors Q-111 and Q-112 provide current source to portions of the amplifier and CR-101, CR-102 and CR-104 and CR-105 provide bias to portions of the amplifier. Fuses F-3 and F-4 prevent excessive current from being drawn in the output circuit. Potentiometer R-118 INT POS permits adjustment of pen centering while R-126 EQL OVER control, permits equalization of power gains of the two halves of the D.C. error amplifier. Diodes CR-106 and CR-107 protect transistor Q-107, diode CR-103 provides temperature compensation, and diode CR-108 provides bias for transistors Q-109 and Q-110.

e. Amplifier Power Supply (Supplies two analog recording channels)

1. Unregulated D.C. Power Supply - A step-down power transformer supplies A.C. power to two full wave supplies. The filtered outputs of these supplies are approximately 35 volts each. The common point is not connected to the assembly frame or chassis. The -35 volt output is supplied to the final stages of the amplifier and the regulated power supply while the + 35 volt output is connected to the regulator only.

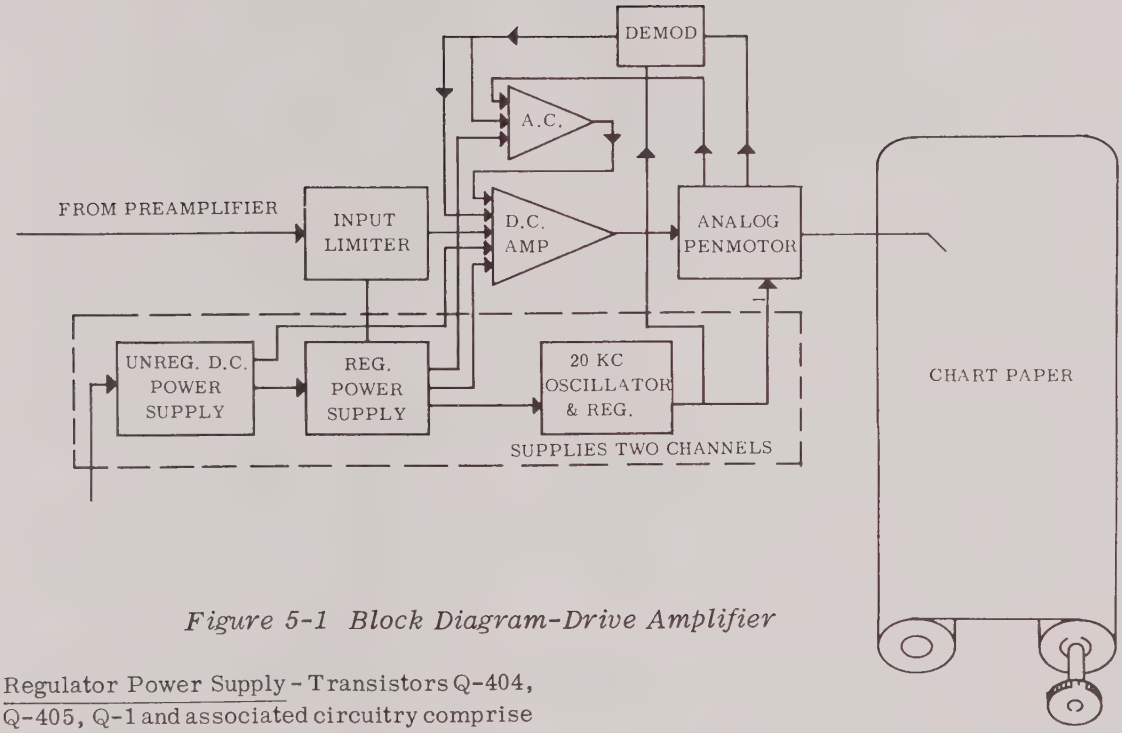


Figure 5-1 Block Diagram-Drive Amplifier

2. Regulator Power Supply - Transistors Q-404, Q-405, Q-1 and associated circuitry comprise a voltage regulator referenced by a zener diode CR-401 and adjusted by R-406 SET 24 to provide regulated 24 volts. Zener diode CR-404 provides shunt regulation to -5 volts and zener diode CR-405 provides shunt regulation to + 5 volts. Transistors Q-405 and Q-3, isolated by transistor Q-2, comprise an oscillator amplifier circuit whose frequency is adjusted by L-401 SET 20 KC and amplitude controlled by transistor Q-408. Transistors Q-406 and Q-407, referenced by zener diode CR-406, control transistor Q-408 which is protected by diode CR-407. Diode CR-409, temperature compensated by diode CR-408, samples the 20 KC output while R-415 SET 8 volts, rms, permits amplitude adjustment.

5.3 EVENT AMPLIFIER, 13-5281-01

The event amplifier (Fig. 5-2) is capable of driving an 8-channel multimarker penmotor. The amplifier consists of four input relays, one confidence check power supply, two power isolation transformers, and two event amplifier printed circuit assemblies. Each event amplifier printed circuit assembly contains four identical circuits consisting of D.C. power supply and D.C. amplifier. Each channel contains an individual power supply consisting of an isolated secondary winding of transformer T-801 or T-802, diode CR-801, resistor R-801 and R-802, and an external 500 microfarad capacitor (C-801 to C-808). Supply voltage, with no output, is + 35 to + 45 volts D.C. At full load, supply voltage is + 25 to + 35 volts D.C. This variation in supply voltage ensures a rapid transition from no output to full output since a decrease in supply voltage decreases reverse bias on transistor Q-802.

Input signals are applied to input connector J-801, located on front of event amplifier. The signal passes thru normally closed contacts of input relay to event amplifier input (WB-1, WB-2). Input transistor Q-802 is biased at cutout thru action of potentiometer R-809 in series bias circuit CR-804, R-809, CR-805, and CR-802. If transistor Q-802 is cutoff, transistors Q-801 and Q-803 are also cutoff. The output is zero current under these conditions. When input signal becomes more positive than bias voltage on wiper of R-809, transistor Q-802 will conduct, causing transistors Q-801 and

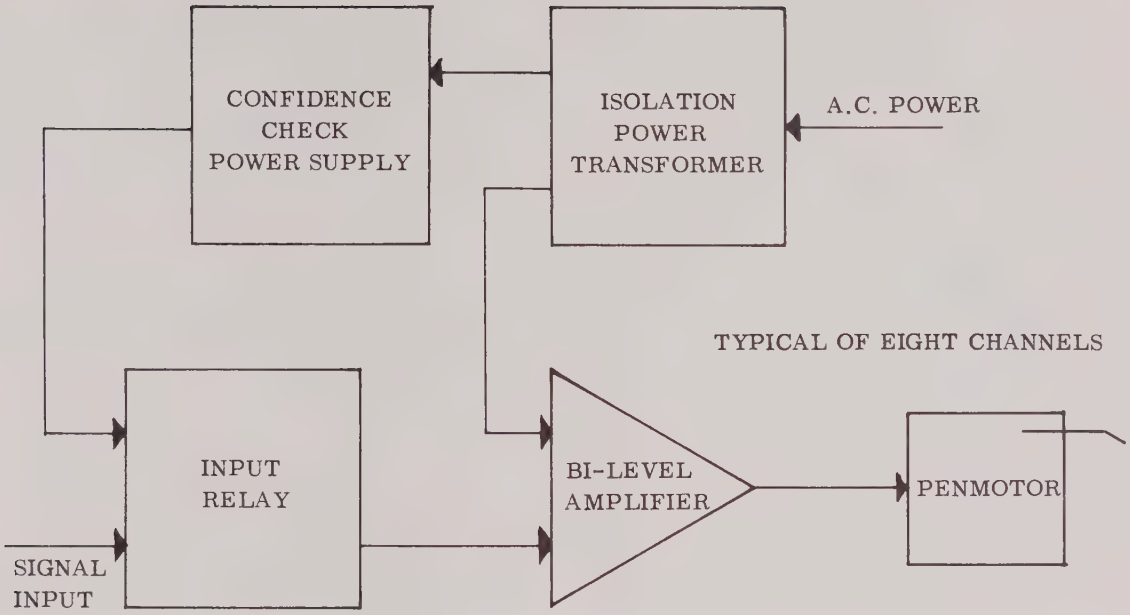


Figure 5-2 Block Diagram - Event Amplifier

Q-803 to conduct, raising output voltage to a maximum of 24 volts. The output voltage is limited by zener diode CR-803. Removing the input voltage will cause the amplifier to return to the off condition.

The confidence check power supply, located on WB-3, contains a full wave power supply consisting of secondaries CR-821 and CR-822, filter capacitor C-820 and filter resistor R-823. This output is reduced to approximately 6 volts D.C. by the action of series resistor R-820, diode string CR-823 thru CR-825, and filter capacitor C-821. Resistor R-821 is adjusted for 5 volts between pins 2 and 5 of WB-3.

Section VI
Maintenance

6.1 GENERAL

This section describes and illustrates removal, installation, and adjustment procedures that can normally be performed at the field maintenance level.

6.2 ANALOG PEN REPLACEMENT

NOTE: Removal and installation procedures for the 40 mm and 80 mm penmotor pens are identical.

a. Removal

1. Turn off power to recorder.

2. Raise chart drive panel assembly to gain access to pens.

3. Reach up under drive panel and, with screwdriver or similar object, shut off ink supply to pen.

NOTE: Each pen has an individual ink valve. Slide valve to the OFF position.

4. Disconnect pen tubing at manifold.

CAUTION: Do not pull tubing from manifold as this may damage manifold. Carefully work tubing loose from nipple and slide tubing from manifold.

5. Loosen set screw securing pen to drive arm hub. Set screw located on side of hub (Fig. 6-1).

NOTE: Do not loosen screw more than one-half turn or pen will not come out of hub.

6. Carefully slide pen up and out of penmotor drive arm hub.

b. Installation

1. Carefully slide pen down into penmotor drive arm hub.

2. Gently tighten set screw that secures pen into drive arm hub.

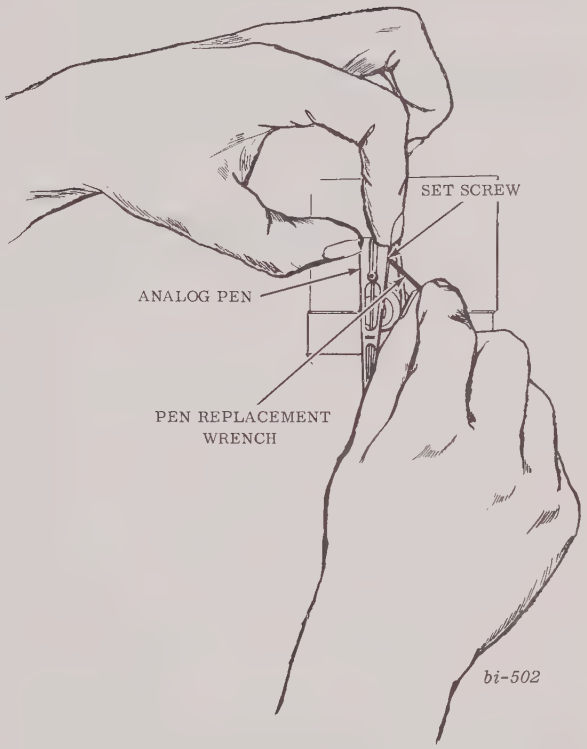


Figure 6-1 Analog Pen Replacement

NOTE: This is not a final setting.

3. Slide tubing onto manifold nipple. Be careful to avoid kinking or creasing pen tubing.

NOTE: Do not use tweezers or other sharp instruments when installing tubing.

4. Slide individual ink valve to ON position.

5. Turn on instrument.

6. Start the chart paper moving by selecting a slow chart speed.

7. Lift pen slightly to allow ink to feed thru pen tip.

8. Stop chart so that pen tips are close to a timing line on chart paper.

9. Grasp rear of pen and push pen across channel width. The trace should be parallel to a time line running across channel width.

NOTE: If adjustment is necessary, gently turn pen in hub of penmotor until pen tip, at maximum swing, is same distance from timing line as when pen is centered.

10. Tighten set screw securing pen in penmotor drive arm.

11. If pen tips are not on same time line, loosen two pan-head adjustment screws on pen and slide pen up or down until all pen tips are on same time line; tighten screws.

12. Check pen pressure (Para. 6.4).

13. Lap pen (Para. 6.6).

14. Lower chart drive panel assembly.

6.3 EVENT MARKER PEN REPLACEMENT

a. Removal

1. Turn off power to recorder.

2. Raise chart drive panel assembly to gain access to pens.

3. Reach up under drive panel and, with screwdriver or similar object, slide individual ink valve to OFF position.

4. Disconnect pen tubing at manifold.

CAUTION: Do not pull tubing from manifold as this may damage manifold. Carefully work tubing loose from nipple and slide tubing from manifold.

5. Loosen, but do not remove, two screws securing pen to event marker.

6. Slide pen down from event marker penholder support.

b. Installation

1. Slide event marker pen onto penholder support and adjust position so that tip is at same time line position as other pens and centered in space between channels.

2. Secure pen in position by tightening two screws loosened in step 5 above.

3. Hold back armor on ink tubing and slide tubing onto manifold. Be careful to avoid kinking or creasing.

NOTE: Do not use tweezers or other sharp instruments when installing tubing.

4. Slide individual ink valve to ON position.

5. Check pen pressure (Para. 6.4).

6. Lap pen (Para. 6.6).

7. Lower chart drive panel assembly.

8. Slide recorder into rack and install four screws.

6.4 PEN PRESSURE MEASUREMENT

The gram gage, supplied with the instrument, is used to measure the pressure of both analog and event marker writing pens. The proper writing pressure for analog pens is 28-32 grams. The proper writing pressure for event marker pens is 20-25 grams. To check pen pressure, proceed as follows:

1. Turn on power to the unit.

2. Select a slow chart speed.

3. Place gram gage hook under pen shaft, as close as possible to the tip, and form a right angle to the pen shaft with the gage body (Fig. 6-2).

4. Raise the gage and take reading the moment pen tip leaves surface of the paper. This is noted by an increase in trace width or a blot of ink.

5. If reading is not within specified gram limits, refer to Paragraph 6.5 for pen pressure adjustment.

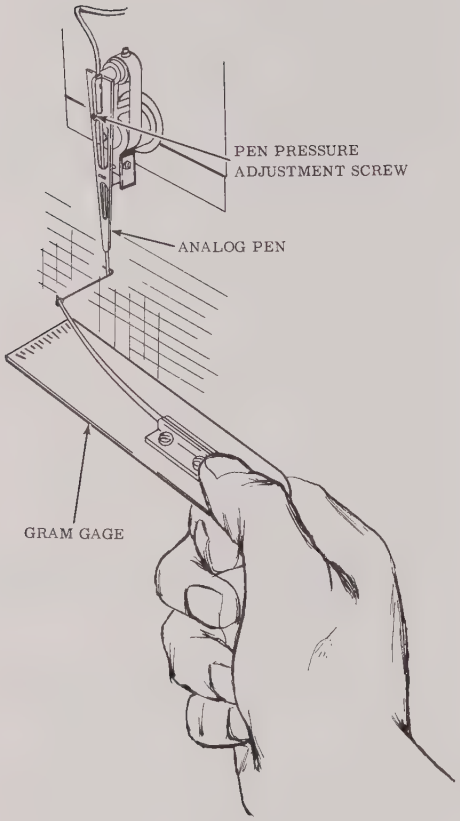


Figure 6-2 Pen Pressure Measurement

NOTE: Generally speaking, pen pressure adjustment is not required if analog pen pressure is between 20 and 30 grams or event marker pen pressure is between 20 and 25 grams and pens are writing correctly. Pen pressure under 20 grams may cause bleeding of ink. Over 30 grams (analog pen) or 25 grams (event marker pen) pressure may cause excessive wear and/or friction.

6.5 PEN PRESSURE ADJUSTMENT

Writing pressure of the analog and event marker pens is adjusted at the factory before shipment; however, when new pens are installed, adjustment may be necessary. Wide ink traces may indicate insufficient pen pressure, and damage to the chart paper at the pen tip may indicate too much pen pressure. Pressure adjustments of both analog and event marker pens are described below.

1. Turn off instrument.
2. Raise chart drive panel assembly to gain access to pens.
3. Measure pen pressure (Para. 6.4).
4. Adjust as required. Turn pen pressure adjustment screw clockwise to increase pressure or counterclockwise to decrease pressure (Fig. 6-3).
5. Recheck pen pressure with gram gage and continue adjustment until proper reading is obtained.
6. Lower chart drive panel assembly.

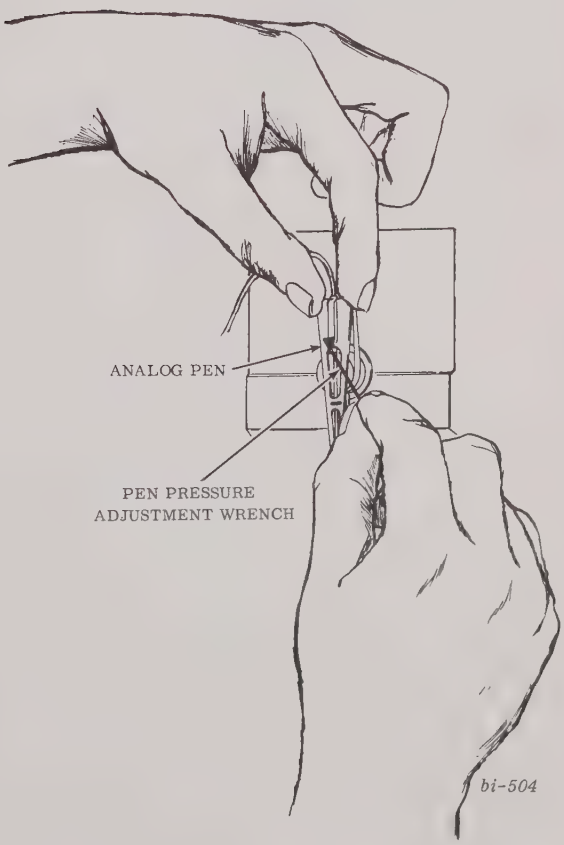


Figure 6-3 Pen Pressure Adjustment

6.6 LAPPING WRITING PENS

The writing pens, which are factory installed in the oscillograph, are properly lapped at time of installation; however, when a replacement pen is installed, pens must be lapped.

a. Analog Pens

1. Turn off instrument.

2. Raise chart drive panel assembly to gain access to pens.

3. Place a small strip of emery paper, supplied with the unit, under pen tip.

CAUTION: Do not lift pens higher than is necessary to place paper under pen tip.

4. Hold emery paper with one hand and place index finger of other hand at one side of writing pen (Fig. 6-4).

5. Gently move the pen right, then left, full scale making approximately 10 passes over emery paper.

NOTE: Use anew area of emery paper on each pass.

6. Remove the emery paper carefully and proceed to next pen.

b. Event Marker Pens

NOTE: It is necessary for the chart to be operating in order to lap event marker pens.

1. Turn on instrument.

2. Raise chart drive panel assembly to gain access to pens.

3. Place a small strip of emery paper, supplied with unit, under pen tip and hold in place.

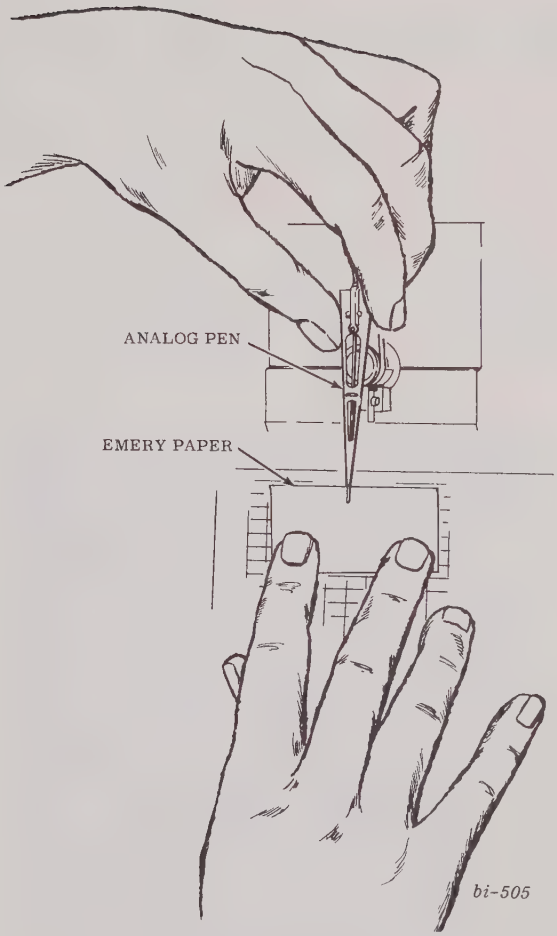


Figure 6-4 Lapping Pens

4. Select a slow chart speed and allow to operate for 20 to 30 seconds.

5. Press STOP button and remove emery paper.

6. Lower chart drive panel assembly.

Section VII
Calibration

7.1 GENERAL

This section contains calibration procedures for the Brush Mark 240 Recorder. The unit is calibrated at the factory and normally does not require adjustment. However, because of parts repair or replacement, it may be necessary to calibrate the effected channel or the entire unit. Do not attempt to adjust the unit unless a performance check verifies that the system is definitely out of calibration.

This calibration procedure is for the drive amplifiers. Refer to the preamplifier manual for calibration of the preamplifiers.

NOTE: Interchanging amplifier plug-in assemblies will result in impaired accuracy and require recalibration.

7.2 TEST EQUIPMENT

The following is a list of recommended test equipment required for calibration of the amplifiers:

1. Fluke Meter, Model 803
2. Hewlett-Packard 202A Low Frequency Function Generator
3. Variable D.C. Power Supply (0-150 volts)
4. Battery operated 2.500 volt power supply

7.3 DRIVE AMPLIFIER, MODELS 15-5221-11 and 15-5221-21

a. Preliminary

1. Turn on power and allow recorder to warm-up for approximately 15 minutes to stabilize.
2. Turn off power to recorder.
3. Remove appropriate drive amplifier from chassis and place amplifier upside downon working surface.
4. Connect one end of Extender Cable, Model 11-1508-03, to drive frame and other end to chassis.
5. Turn on power to recorder and select a slow chart speed.
6. Adjust left and right pen limiter potentiometers on front of drive amplifier (Fig. 7-1) for pen limits of approximately three lines past channel edge. Apply AC Triangle wave.

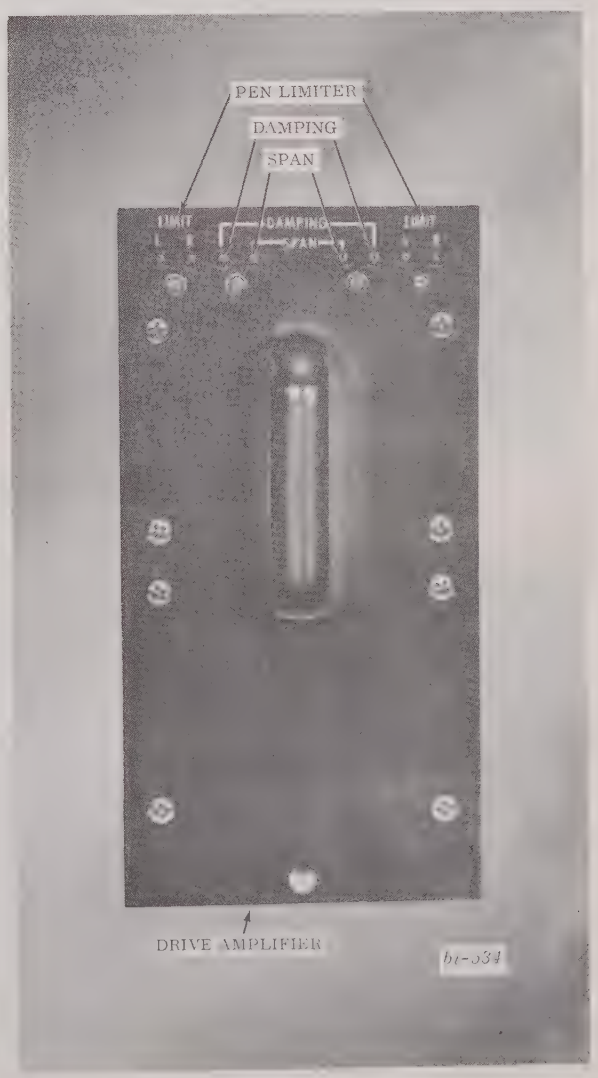


Figure 7-1 Limit, Span and Damping Controls

7. Press chart speed stop button and attach a voltmeter from either 1/8 ampere fuse on side plate to minus end of electrolytic capacitor mounted in a spring clip on one side plate.

8. Check for reading of -26 ±.5 volts. If necessary, adjust 26 volt potentiometer (A, Fig. 7-2) until required voltage is obtained.

9. Attach a voltmeter from inside terminal of 100 ohm resistor (H, Fig. 7-2) to second terminal from adjustment potentiometers (G, Fig. 7-2) on amplifier board.

NOTE: A jumper lead replaces the 100 ohm resistor on Model 15-5221-11, but procedure remains the same.

10. Check for readings of 7.0 ± .2 volts, rms, on Model 15-5221-11 amplifier or 7.5 ± .2 volts, rms, on Model 15-5221-21 amplifier. If necessary, adjust 20 KC level control (B, Fig. 7-2) until required voltage is obtained.

11. Attach a voltmeter from inside terminal of 100 ohm resistor (H, Fig. 7-2) to stud of Q-4, 7, 8, or 11 on outside plate of drive amplifier. * Turn Drive on. 5mv/.01
Q4&Q7 is one channel.
Q8&Q11 is one channel.

12. Check for reading of -13 volts D.C. if necessary, adjust EQL OVER control (C, Fig. 7-2) until required voltage is obtained.

13. Disconnect drive amplifier input leads from TB-104 on rear of recorder.

14. Alternately open and short appropriate leads and observe for pen movement in channel being calibrated. If necessary, adjust I_{CO} BAL control (D, Fig. 7-2) until there is a minimum or no pen movement.

15. Short appropriate leads and, if necessary, adjust INT POS control (E, Fig. 7-2) until pen is exactly at chart center.

b. Gain Adjustment

1. Select a medium chart speed on the control panel.

2. Apply 2.500 volts directly to appropriate drive amplifier leads and check for pen deflection to edge of channel. If proper deflection is not obtained, adjust SPAN control on front of amplifier (Fig. 7-1) until pen deflects to channel edge.

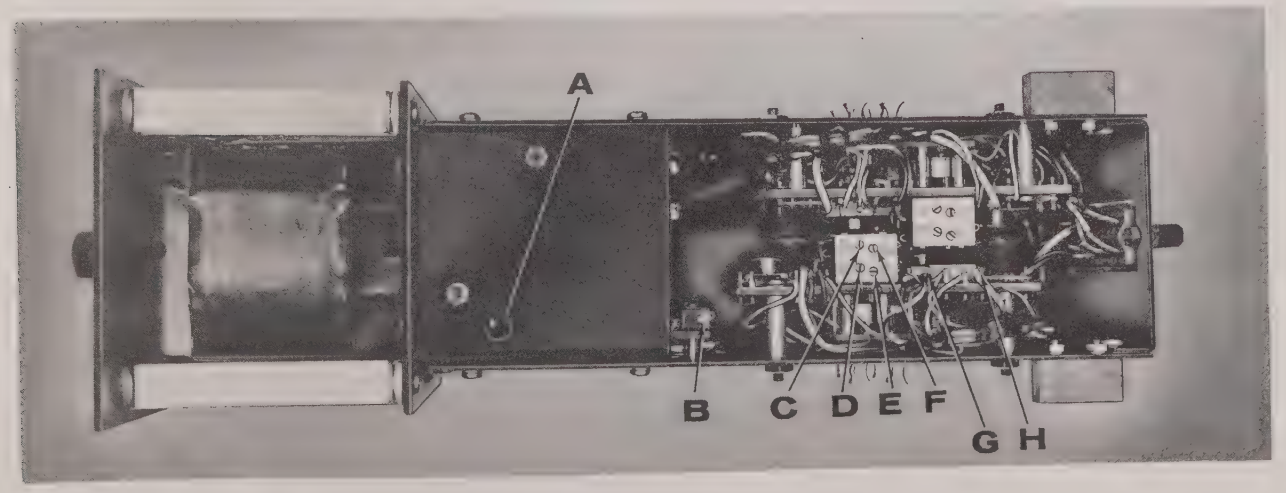


Figure 7-2 Calibration Test and Adjustment Points

NOTE: It is recommended that the 2.500 volts be applied using a battery operated power supply and monitored with a Fluke Meter (Model 803 or equivalent).

c. Damping Adjustment

1. Apply a 10 cps sine wave amplitude of 20% of full scale. * 10 div.

2. Switch frequency to 100 cps and, if necessary, adjust DAMPING control (Fig. 7-1) until trace amplitude is exactly 20% of full scale. Peak-to-peak amplitude should be flat within ±4% over entire range.

3. Apply a 5.5 cps full scale sine wave to 40 mm channels (Model 15-5221-11 drive amplifier). On 80 mm channels (Model 15-5221-21 drive amplifier), apply a 5.5 cps sine wave amplitude of 50% of full scale. * 25 Div.

4. Switch frequency to 55 cps and, if necessary, adjust CRS DAMP control (F, Fig. 7-2) until 5.5 and 55 cps amplitudes are equal.

NOTE: Do not apply 55 cps signal for more than 3 seconds out of any 15 seconds while making these adjustments.

5. Repeat steps 1 thru 4 until all conditions are met. Use DAMPING control only to adjust 100 cps amplitude and CRS DAMP control only to adjust 55 cps amplitude.

NOTE: The following applies to Model 15-5221-21 drive amplifier only.

6. Apply a full scale one cps sine wave to 80 mm channels and increase frequency to 35 cps peak-to-peak. If amplitude is not flat within ± 2% of full scale, repeat steps 1 thru 4.

7. Turn off power to recorder.

8. Connect leads to TB-104 on rear of recorder.

9. Plug amplifier into chassis.

d. Limiter Adjustment

1. Apply an A.C. triangle wave of sufficient amplitude to allow pens to travel approximately two divisions beyond full scale.

2. Adjust potentiometer (L and R, Fig. 7-1) until pen travel is one division beyond full scale.

3. Apply a .1 to 1 cps triangle signal, full scale, to the input. Select a chart speed and triangle rate so that sides of triangle are at a 90 degree angle. Visually check sides of triangle for straightness.

e. Recorder Checkout

After calibration of drive amplifiers, apply signals directly thru preamplifier input and repeat step c to check frequency response. Recorder is now calibrated.

Section VIII
Troubleshooting

8.1 GENERAL

This section contains a troubleshooting table to assist operating personnel in isolating the cause of malfunctions which may occur in the Mark 240 Recorder. Since this manual is basically an operator's manual, it may be necessary to contact your Brush Service Representative for assistance in restoring your Mark 240 Recorder to top operating condition.

CAUTION: All maintenance on this system should be performed in conjunction with, or by qualified personnel.

8.2 TROUBLESHOOTING TABLE

MALFUNCTION	CAUSE	REMEDY
1. Recorder inoperative.	a. Power cable not connected.	a. Connect power cable.
	b. Blown fuse.	b. Replace fuse.
	c. Main POWER switch not in ON position.	c. Place switch in ON position.
	d. Interlock switch open indicating one of the following:	
	(1) Paper supply exhausted	(1) Load chart paper
	(2) Writing table not in proper position	(2) Position writing table
	(3) Faulty interlock switch.	(3) Replace interlock switch.
2. No power to pens.	Blown fuse.	Replace fuse.
NOTE: No power to pens is normal if chart speed STOP button is depressed.		
3. Chart paper drive does not operate.	a. Main POWER switch not in ON position.	a. Place switch in ON position.
	b. Chart speed STOP button depressed.	b. Select proper speed.
	c. LOCAL or REMOTE button not depressed.	c. Depress proper button.
	d. Lack of power at source.	d. Connect to correct power source.

MALFUNCTION	CAUSE	REMEDY
3. Chart paper drive does not operate (Continued).	e. Interlock switch open.	e. Check for open paper drawer or exhausted paper supply.
	f. Defect in transmission; motor is running.	f. Replace transmission.
	g. Drive belt broken.	g. Replace drive belt.
	h. Defective drive motor.	h. Replace motor.
	i. Incorrect paper tension.	i. Set paper tension.
4. Chart paper speed is not as indicated by CHART SPEED buttons or does not change properly as CHART SPEED buttons are depressed.	a. Defective transmission.	a. Replace transmission.
	b. Defective contacts on CHART SPEED switch.	b. Replace switch.
	c. Incorrect line voltage or frequency.	c. Check line voltage and frequency.
5. Pen writes intermittently or not at all.	a. Insufficient ink supply.	a. Fill ink master cylinder.
	b. Pen clogged.	b. Clean pen.
	c. Individual ink valve in OFF position.	c. Slide ink valve to ON position.
	d. Manifold tube rotated out of position.	d. Reset manifold tube.
6. Individual pen trace extremely heavy.	a. Improper pen pressure.	a. Adjust pen pressure.
	b. Pen tip not fully in contact with paper.	b. Lap pen.
	c. Noise coming thru drive amplifier or signal source.	c. Switch amplifier or channel on penmotor plugs to isolate source.
7. Pen tip gouges or tears paper.	Improper pen pressure.	Adjust pen pressure.
8. Pen will not travel on timing line.	Improper pen alignment.	Align pen.

MALFUNCTION	CAUSE	REMEDY
9. Both pens do not move.	a. Apply a signal to the drive amplifiers. If neither pen moves, failure is in D.C. power supply, or drive amplifier relays.	a. Refer to drive amplifier schematic wiring diagram.
	b. If signal is applied to drive amplifiers and pens move uncontrollably to one side of chart, failure is in 20 KC Power Supply.	b. Refer to drive amplifier schematic wiring diagram.
	c. If signal applied to drive amplifiers causes pens to move normally, failure is in preamplifier circuits or inputs.	c. Refer to preamplifier schematic wiring diagram.
10. One pen does not move or moves uncontrollably.	a. Penmotor failure.	a. Plug penmotor harness from operating channel into failed penmotor. If pen does not move, penmotor defective and must be replaced.
	b. Apply a signal to the drive amplifiers. If pen moves normally, failure is in the preamplifier. If pen does not move, failure is in drive amplifier.	b. Refer to drive amplifier schematic wiring diagram.
11. Amplifier inoperative.	a. Blown fuse on power supplies.	a. Replace fuse or fuses as necessary.
	b. Amplifier not positioned properly.	b. Press fully into position.
12. Any two connected channels stop operating.	a. One dual drive amplifier assembly inoperative.	a. Replace drive amplifier.
	b. Defective cabling.	b. Replace defective cabling.
	c. Loose connections.	c. Check all connections.
13. Any one channel stops operating.	Fuses blown on side of drive amplifier associated with dead channel.	Replace fuse or fuses as necessary.

SECTION IX
PARTS IDENTIFICATION

9.1 GENERAL

This instrument has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Brush Service Engineer listed on the warranty card shipped with the recorder.

The following parts list and schematic diagrams are designed to assist in servicing and repairing the recorder.

NOTE: Check to be sure the schematic number and revision letter stamped on the rear of the instrument agree with the number and revision letter on the schematic contained in this section.

To assure prompt and satisfactory delivery of replacement parts, include the following with the purchase order:

1. Name, model number and serial number of the instrument.

   For Example: Brush 240 Recorder, Model XXXX-6607-10, Serial Number

2. Description of the part as listed in the parts list.

3. Brush part number

NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.

EXPLODED VIEW PARTS LIST
RECORDER SYSTEM, BRUSH 240 (ALL MODELS) - FIGURE 9-1

ITEM NO.	DESCRIPTION	PART NUMBER
1	Power Supply, Preamplifier	13-7102-01 (See Figure 9-2)
2	Power Supply, Preamplifier	13-7104-01 (See Figure 9-2)
3	Power Supply Asm	862694 (See Figure 9-6)
4	Cable Asm, Power Input	232888-910
5	Timer Asm	Per Customer Order (See Para. 1.3)
6	Amplifier Asm, 40 MM	15-5221-11(See Figure 9-8)
6	Amplifier Asm, 80 MM	15-5221-21 (See Figure 9-8)
6	Amplifier Asm, Multimarker	13-5281-01 (See Figure 9-14)
7	Chassis Asm	863444
8	Bracket Asm	762765
9	Chart Drive Asm	861577 (See Figure 9-17)
10	Name Plate	243190
11	Shelf Asm	862810 (See Figure 9-23)
12	Label, Channel Identification	361687-1
13	Spring, Flat	263015
14	Signal Conditioner	Per Customer Order
15 (Not Shown)	Chart Take-Up	11-6402-02 (See Figure 9-24)

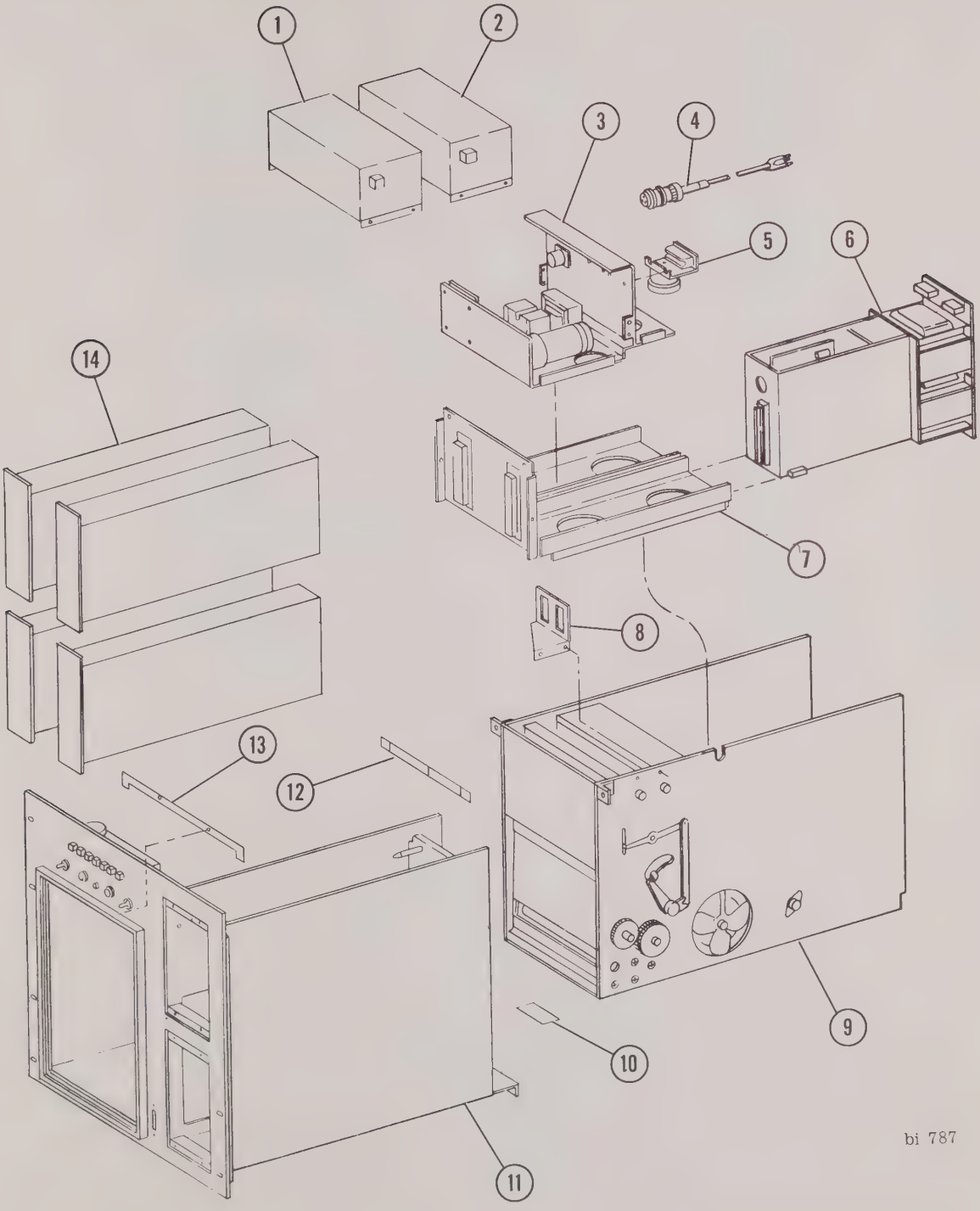


FIGURE 9-1
BRUSH 240 RECORDER SYSTEM (ALL MODELS)

EXPLODED VIEW PARTS LIST
PREAMPLIFIER POWER SUPPLY MODEL 13-7102-01 AND 13-7104-01 - FIGURE 9-2

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Cover Asm	762846	
2	Power Supply, Pre-Amp (See Figure 9-3)	13-7102-00	
2	Power Supply, Pre-Amp (See Figure 9-3)	13-7104-00	
3	Transformer	262819	T-303
4	Chassis Asm	762847	
5	Resistor	5-115557-104	R-327
6	Socket, Semiconductor	262624	
7	Capacitor	1-117964-102	C-306
8	Semiconductor	231887	CR-305
9	Terminal Board	100184-3	
10	Resistor	5-119370-501	R-329
11	Semiconductor	231887	CR-305
12	Semiconductor	231887	CR-308
13	Capacitor	240391	C-305
14	Transistor	262804	Q-312
15	Transistor	262804	Q-313
16	Resistor	5-119370-102	R-326
17	Semiconductor	231887	CR-308
18	Socket, Semiconductor	262624	
19	Resistor	5-115557-104	R-328
20	Capacitor	1-117964-102	C-307
21	Transformer	262820	T-302
22	Resistor	5-111111-101	R-325
23	Connector	9-247923-9	J-121

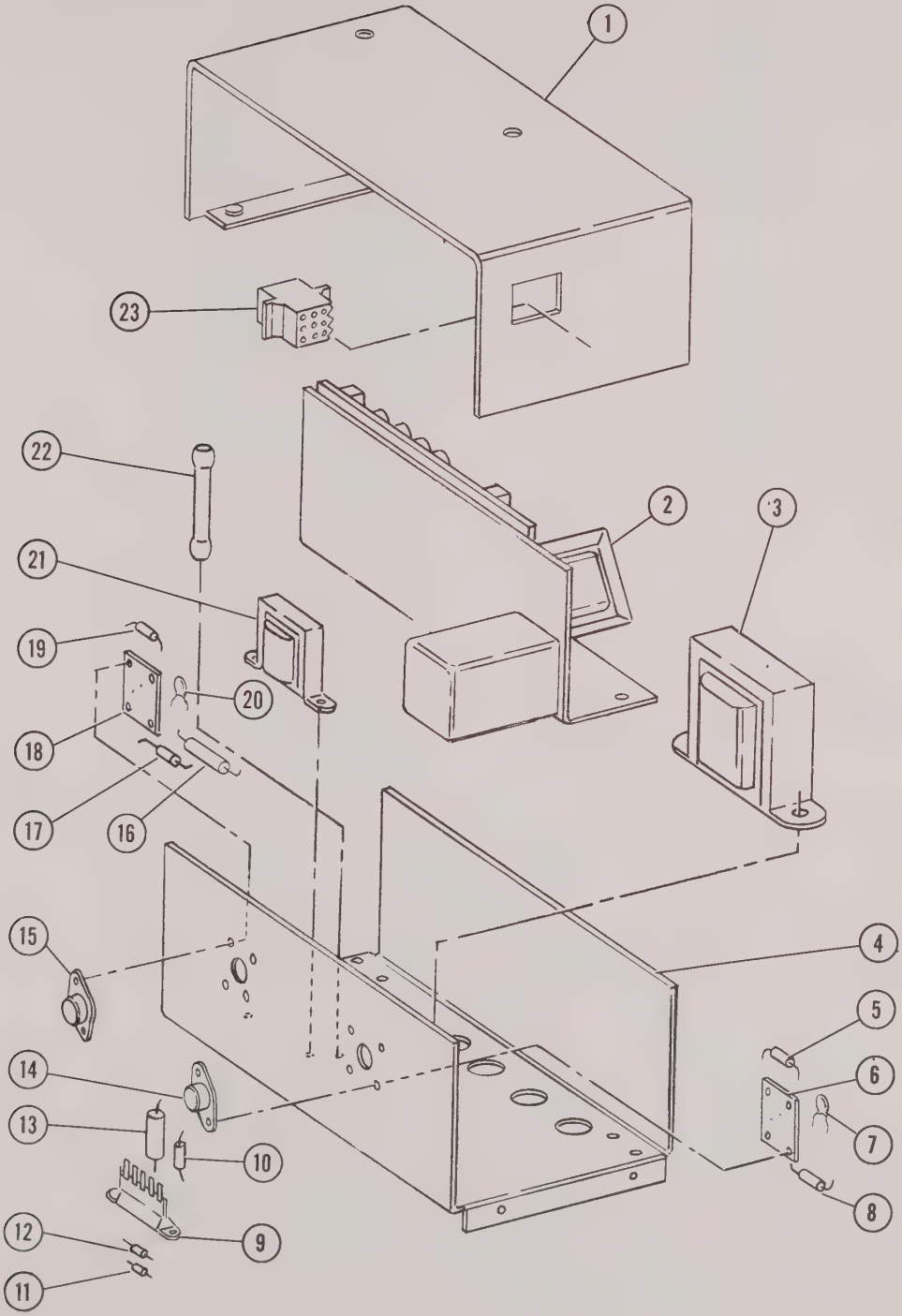


FIGURE 9-2
PREAMPLIFIER POWER SUPPLY MODEL 13-7102-01 AND 13-7104-01

EXPLODED VIEW PARTS LIST
PREAMPLIFIER POWER SUPPLY MODEL 13-7102-00 AND 13-7104-00 - FIGURE 9-3

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Transistor	243077-4	Q-301
2	Transistor	243077-4	Q-302
3	Transistor	243077-4	Q-303
4	Transistor	243077-4	Q-310
5	Transistor	243077-4	Q-311
6	Amplifier Asm, Power (Model 7102-00) (See Figure 9-4)	844375	
6	Amplifier Asm, Power (Model 7104-00) (See Figure 9-5)	844376	
7	Transformer (Model 7102-00)	244384	T-301
7	Transformer (Model 7104-00)	244384	T-201
8	Nut Asm	343626-910	
9	Filter (Model 7102-00)	243627	FL-301
9	Filter (Model 7104-00)	243628	FL-201

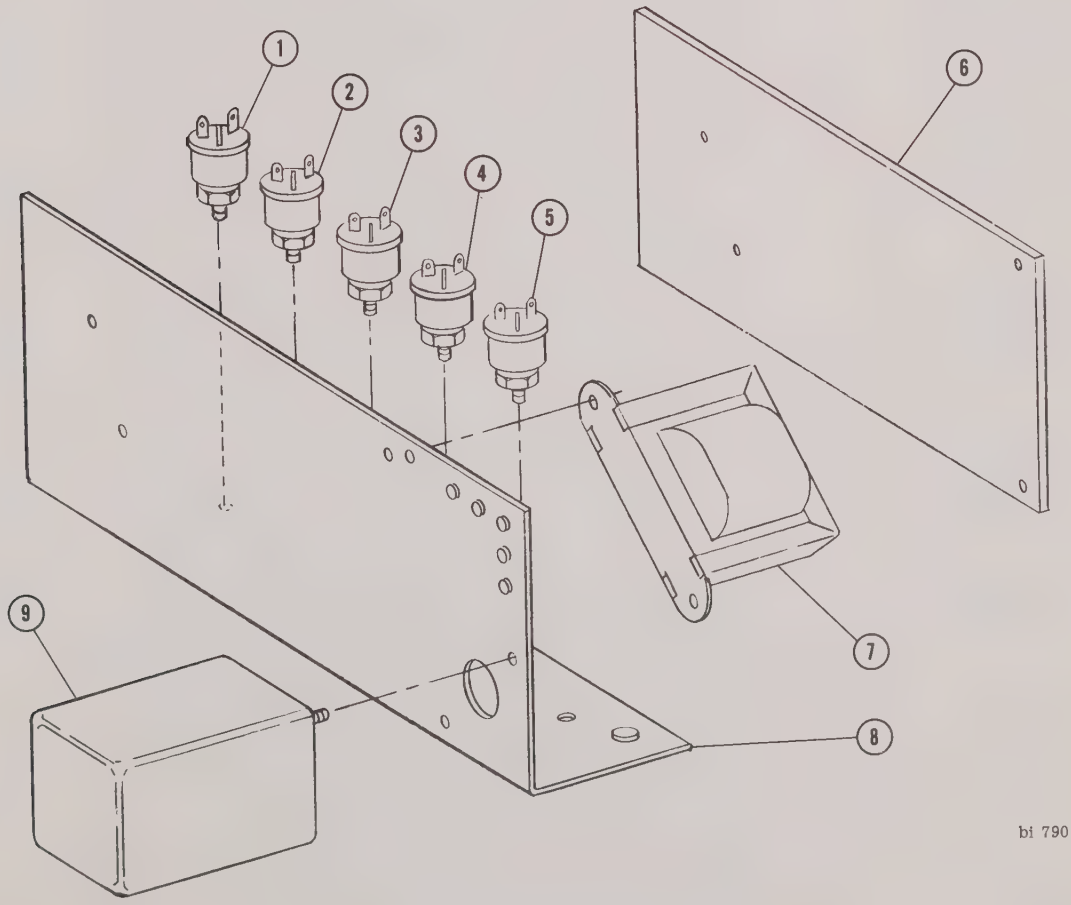


FIGURE 9-3
PREAMPLIFIER POWER SUPPLY MODEL 13-7102-00 AND 13-7104-00

ELECTRICAL PARTS LIST
AMPLIFIER ASM, POWER SUPPLY 844375
MODEL 13-7102-00 FIGURE 9-4

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-303	Capacitor	10-241145-204
C-304	Capacitor	10-241145-115
C-305	Capacitor	10-241145-503
C-306	Capacitor (13-7102-01 only)	1-117964-102
C-307	Capacitor (13-7102-01 only)	1-117964-102
C-308	Capacitor	10-125904-332
CR-301	Semiconductor	240333
CR-302	Semiconductor, 1N816	231869
CR-303	Semiconductor, 1N816	231869
CR-304	Semiconductor	242853
Q-304	Transistor, 2N1370	231884
Q-305	Transistor, 2N1370	231884
Q-306	Transistor, 2N491	129063
Q-307	Transistor	242323
Q-308	Transistor	242323
Q-309	Transistor, 2N1370	231884
R-301	Resistor	5-115557-332
R-302	Resistor	1-128182-6801
R-303	Resistor	5-115557-123
R-305	Resistor	5-115557-394
R-306	Resistor	1-128182-8000
R-308	Resistor, Variable	243380-501
R-309	Resistor	1-128182-3301
R-310	Resistor	1-128182-2002
R-311	Resistor	5-115557-101
R-312	Resistor	5-115557-331
R-313	Resistor	5-115557-562
R-314	Resistor	1-128182-5101
R-315	Resistor, Variable	243380-202
R-316	Resistor	5-115557-822
R-317	Resistor	5-115557-822
R-318	Resistor	5-115557-271
R-319	Resistor	5-115557-331
R-320	Resistor	5-115557-271
R-321	Resistor	5-115557-331
R-322	Resistor	5-115557-562
R-323	Resistor	5-115557-332
R-324	Resistor	5-115557-151

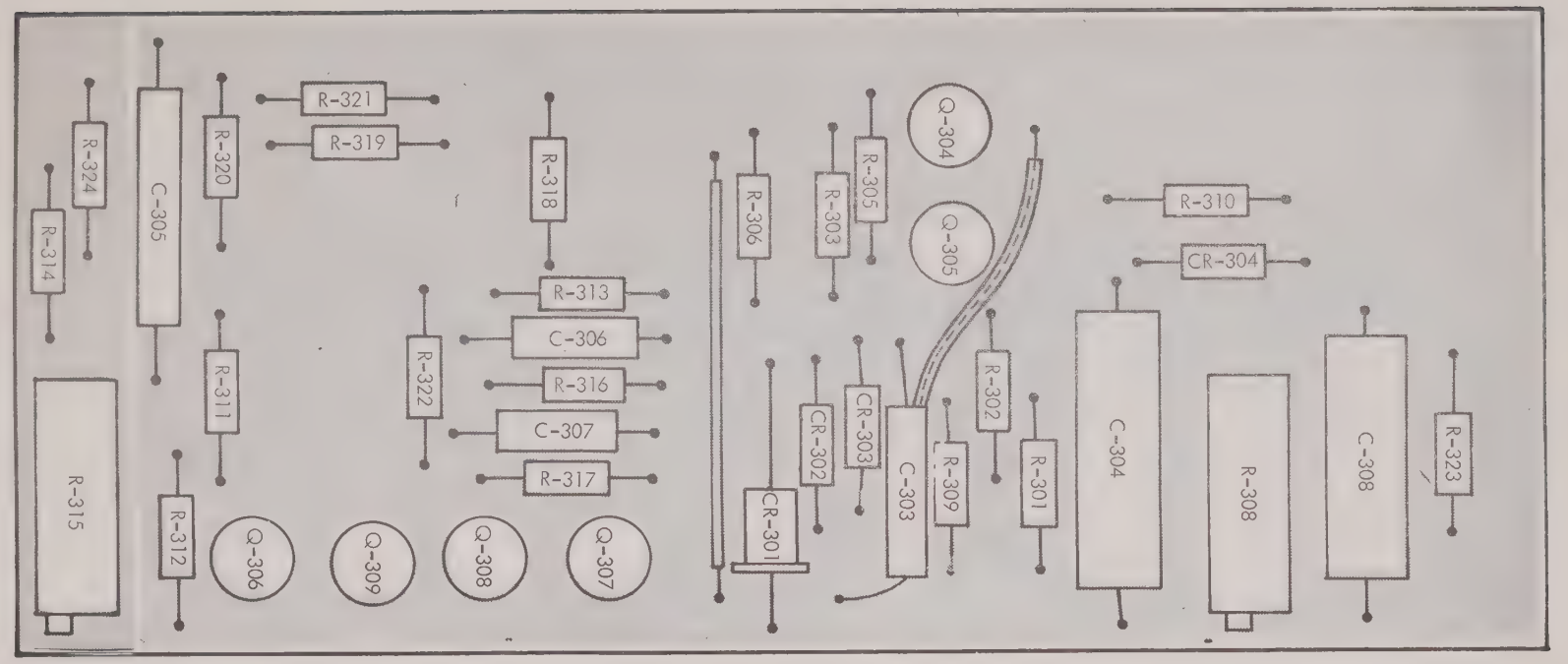


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FIGURE 9-4
POWER SUPPLY AMPLIFIER ASM. 844375 MODEL 13-7102-00

ELECTRICAL PARTS LIST
AMPLIFIER ASM, POWER SUPPLY 844376
MODEL 13-7104-00 FIGURE 9-5

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-201	Capacitor	10-125904-103
C-202	Capacitor	243006-356
C-204	Capacitor	10-241145-115
C-205	Capacitor	10-125904-154
C-206	Capacitor	10-241145-203
C-207	Capacitor	10-241145-203
C-208	Capacitor	10-241145-364
CR-201	Semiconductor	240333
CR-202	Semiconductor, 1N816	231869
CR-203	Semiconductor, 1N816	231869
CR-204	Semiconductor	242853
Q-204	Transistor, 2N1370	231884
Q-205	Transistor, 2N1370	231884
Q-206	Transistor, 2N491	129063
Q-207	Transistor	242323
Q-208	Transistor	242323
Q-209	Transistor, 2N1370	231884
R-201	Resistor	5-115557-332
R-202	Resistor	5-115557-102
R-203	Resistor	5-115557-123
R-204	Resistor	5-115557-222
R-205	Resistor	5-115557-394
R-206	Resistor	1-128182-8000
R-208	Resistor, Variable	243380-501
R-209	Resistor	1-128182-3301
R-210	Resistor	1-128182-2002
R-211	Resistor	5-115557-101
R-212	Resistor	5-115557-332
R-213	Resistor	5-115557-331
R-214	Resistor	5-115557-562
R-215	Resistor	1-128182-4701
R-216	Resistor, Variable	243380-103
R-217	Resistor	5-115557-822
R-218	Resistor	5-115557-822
R-219	Resistor	5-115557-271
R-220	Resistor	5-115557-331
R-221	Resistor	5-115557-271
R-222	Resistor	5-115557-331
R-223	Resistor	5-115557-562
R-224	Resistor	5-115558-331

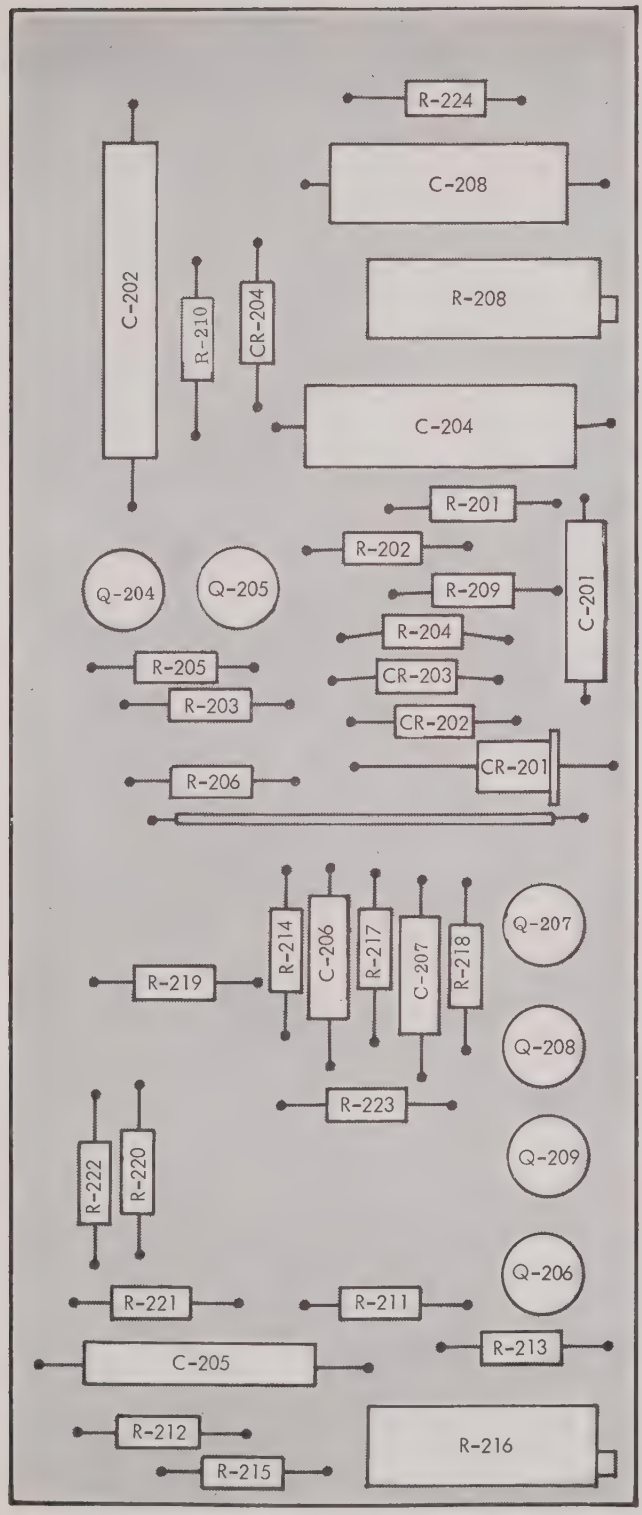

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FIGURE 9-5
POWER SUPPLY AMPLIFIER ASM 844376 MODEL 13-7104-00

EXPLODED VIEW PARTS LIST
POWER SUPPLY ASM 862694 - FIGURE 9-6

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Network Asm (See Figure 9-7)	762688	
2	Capacitor	128020-507	C-101
3	Connector	127532	J-114
4	Bracket	122230-14	
5	Fuseholder	129758	XF-102
6	Fuse, Slo-Blo, 0.5 amp	116198-8	F-102
7	Fuseholder	129758	XF-103
8	Fuse	116198-8	F-103
9	Fuseholder	129758	XF-101
10	Fuse	116198-13	F-101
11	Board, Terminal	1-216886-303	TB-107
12	Spacer	244500-6	
13	Shield	263077	
14	Bracket Asm	762689	
15	Clamp	113876-5	
16	Capacitor	262698	C-102
17	Resistor	5-115558-332	R-101
18	Transformer	343035	T-101
19	Bracket Asm	762690	
20	Transformer	262699	T-102
21	Semiconductor Device	243671-2	CR-117

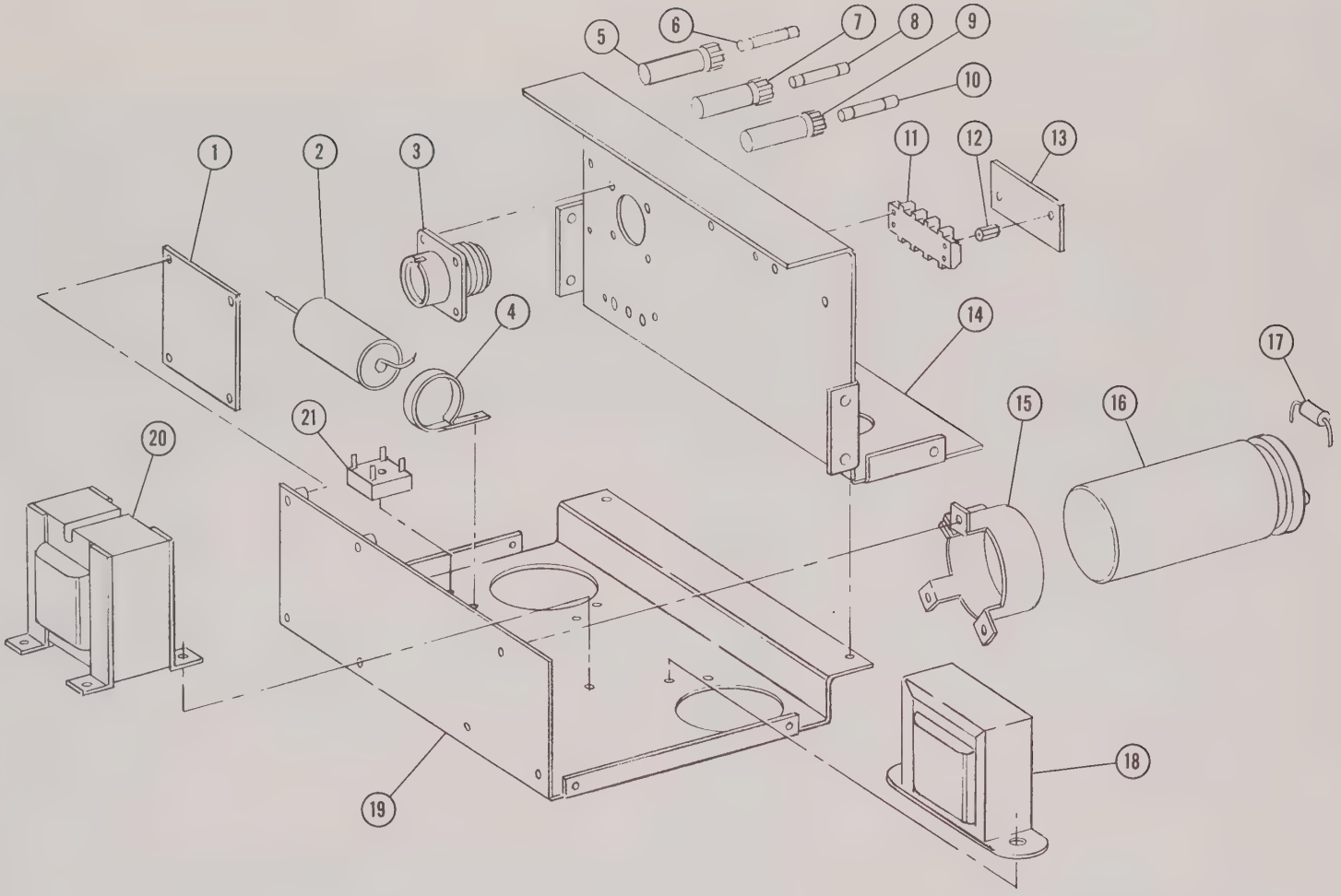

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FIGURE 9-6
POWER SUPPLY ASM 862694

ELECTRICAL PARTS LIST
NETWORK ASM, POWER SUPPLY 762688 - FIGURE 9-7

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-201	Capacitor	243685-107
C-202	Capacitor	248753-102
CR-201	Semiconductor UT910	231887
CR-202	Semiconductor UT1119	249165-1
CR-203	Semiconductor UT1119	249165-1
CR-204	Semiconductor UT910	231887
CR-205	Semiconductor 1N816	231869
CR-206	Semiconductor 1N816	231869
R-201	Resistor	5-115559-112

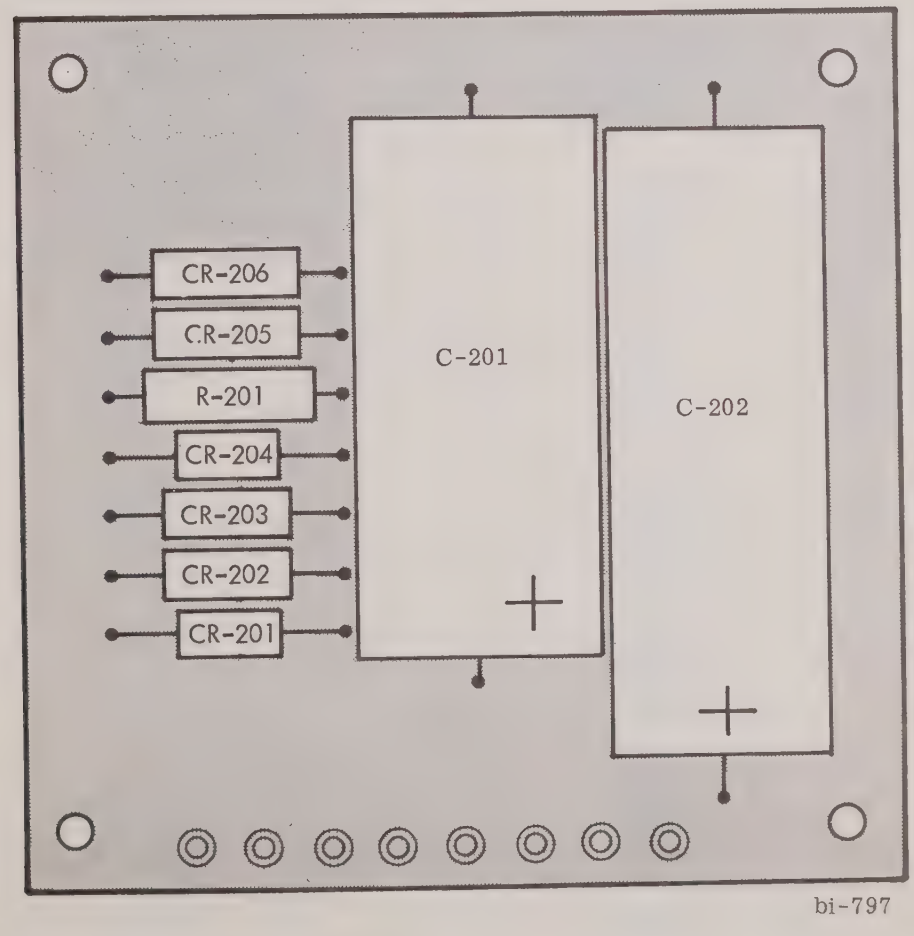

FIGURE 9-7
POWER SUPPLY NETWORK ASM 762688

EXPLODED VIEW PARTS LIST
AMPLIFIER ASM, MODELS 15-5221-11 AND 15-5221-21 - FIGURE 9-8

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Power Supply Asm	848158	
2	Plate Asm	748162	
3	Handle	243675	
4	Retainer, Fastener	242981	
5	Fastener, Stud	243710	
6	Bracket, Angle	242034	
7	Transformer Asm	342875	T-1
8	Nut Asm	647982	
9	Resistor, Fixed (Model 15-5221-11 only)	5-115557-105	R-14
10	Resistor, Variable	243380-502	R-7
11	Resistor, Variable	243380-502	R-6
12	Resistor, Variable	243379-503	R-10
13	Resistor, Variable	243379-503	R-11
14	Resistor, Fixed (Model 15-5221-21 only)	5-115557-222	R-14
15	Resistor, Variable	243379-503	R-13
16	Resistor, Variable	243379-503	R-12
17	Resistor, Variable	243380-502	R-9
18	Resistor, Variable	243380-502	R-8
19	Fuse, 1 amp, "3AG"	102625-7	F-2
20	Fuse, 1 amp, "3AG"	102625-7	F-1
21	Inductor Asm	342874-910	L-1
22	Nut Asm	442707-910	
23	Support, Transformer	342703	
24	Support, Component	442705	
25	Eyelet	1-108463-20	
26	Semiconductor	242640	CR-2
27	Semiconductor	242640	CR-1
28	Lug	232432	
29	Capacitor, Electrolytic	247552	C-1
30	Clamp	113876-2	
31	Spacer	123253-201	
32	Plate Asm, LH	343140-810	
33	Plate Subasm, LH	442785-910	
34	Spacer	127942-302	
35	Spacer	123253-401	
36	Transistor	243077-4	Q-8
37	Resistor	5-242300-1R5	R-4
38	Transistor	243077-4	Q-9
39	Support, Slide	242016	
40	Fuse, 1 amp, "3AG"	102625-7	F-6
41	Fuse, 1/8 amp, "3AG"	102625-2	F-5
42	Holder, Fuse	243054-2	
43	Transistor	243077-4	Q-10
44	Resistor	5-242300-1R5	R-5
45	Transistor	243077-4	Q-11
46	Plate, Key	248180	
47	Bracket Asm	748265	
48	Connector	243002	J-1
49	Capacitor, Fixed	240352-103	C-3
50	Plate Asm, RH	343141-910	

EXPLODED VIEW PARTS LIST
AMPLIFIER ASM, MODELS 15-5221-11 AND 15-5221-21 - FIGURE 9-8 (Continued)

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
51	Plate Subasm, RH	442784-910	
52	Fuse, 1 amp, "3AG"	192625-7	F-4
53	Holder, Fuse	243054-2	
54	Fuse, 1 amp, "3AG"	102625-7	F-3
55	Transistor	243077-4	Q-4
56	Transistor	243077-4	Q-7
57	Limiter Asm, (See Figure 9-9)	748141	
58	Network amp, (Model 15-5221-11) (See Figure 9-10)	848155	
58	Network amp, (Model 15-5221-21) (See Figure 9-11)	848167	
59	Resistor	5-242300-1R5	R-3
60	Resistor	5-242300-1R5	R-2
61	Transistor	243077-4	Q-5
62	Transistor	243077-4	Q-6
63	Transistor	243077-4	Q-1
64	Transistor	243077-4	Q-2
65	Transistor	243077-4	Q-3
66	Resistor	5-115559-222	R-15
67	Resistor, Fixed	245490-501	R-1
68	Clip, Retaining	113529-5	
69	Capacitor, Fixed, Electrolytic	243037-257	C-2
70	Network amp, (Model 15-5221-11) (See Figure 9-10)	848155	
70	Network amp, (Model 15-5221-21) (See Figure 9-11)	848167	
71	Limiter Asm, (See Figure 9-8)	748141	
72	Network, Oscillator Asm (Model 15-5221-11)(See Figure 9-12)	442822	
72	Network, Oscillator Asm, (Model 15-5221-21) (See Figure 9-13)	846584	

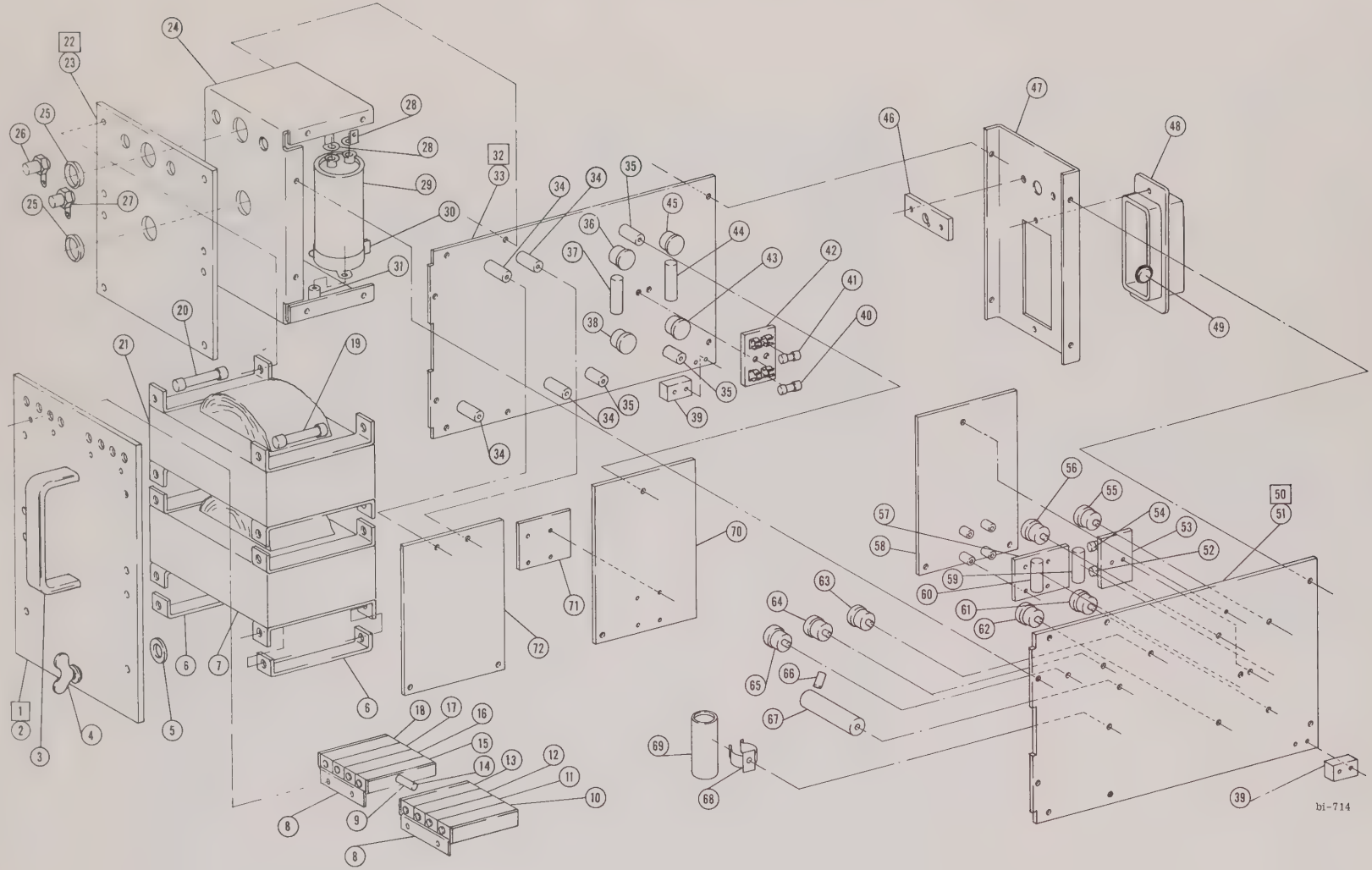

FIGURE 9-8
AMPLIFIER ASM MODELS 15-5221-11 AND 15-5221-21

ELECTRICAL PARTS LIST
AMPLIFIER LIMITER ASM, 748141 FIGURE 9-9

SYMBOL NO.	DESCRIPTION	PART NUMBER
CR-501	Semiconductor, 1N277	244311
CR-502	Semiconductor, 1N816	231869
CR-503	Semiconductor, 1N277	244311
CR-504	Semiconductor, 1N277	244311
CR-505	Semiconductor, 1N816	231869
CR-506	Semiconductor, 1N277	244311
Q-501	Transistor	242323
Q-502	Transistor	242323
R-501	Resistor	1-128182-91671
R-502	Resistor	1-128182-1103
R-505	Resistor	5-115557-822
R-506	Resistor	5-115557-122
R-507	Resistor	5-115557-472

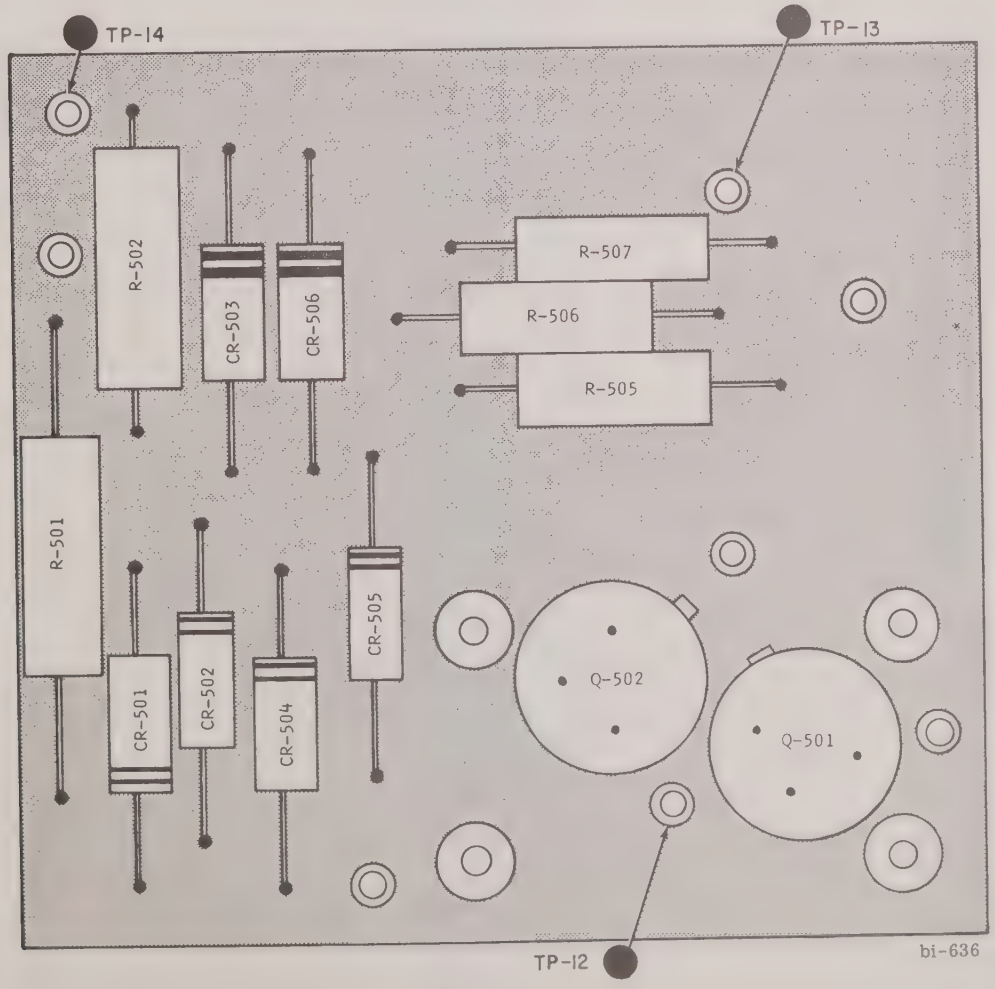

FIGURE 9-9
AMPLIFIER LIMITER ASM 748141

ELECTRICAL PARTS LIST
NETWORK ASM 848155 - FIGURE 9-10

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-101	Capacitor	10-125904-602
C-102	Capacitor	10-241145-204
C-103	Capacitor	10-241145-403
C-104	Capacitor	10-125904-203
C-105	Capacitor	10-125904-303
C-106	Capacitor	231922-256
C-107	Capacitor	231922-256
C-108	Capacitor	10-125904-152
C-109	Capacitor	10-125904-103
C-110	Capacitor	10-231854-560
C-111	Capacitor	10-231854-560
C-112	Capacitor	10-125904-103
C-113		Not Used
C-114	Capacitor	10-125904-602
C-115	Capacitor	240352-302
CR-101	Semiconductor	244311
CR-102	Semiconductor	244311
CR-103	Semiconductor	244311
CR-104	Semiconductor	244311
CR-105	Semiconductor	244311
CR-106	Semiconductor	244311
CR-107	Semiconductor	244311
CR-108	Semiconductor	231869
L-101	Reactor, 250mh	243179
L-102	Reactor, 250mh	243179
L-103	Reactor, 250mh	243179
Q-101	Transistor, PNP	231884
Q-102	Transistor, PNP	243920-3
Q-103	Transistor, PNP	240236
Q-104	Transistor, NPN	240237
Q-105	Transistor, PNP	240236
Q-106	Transistor, NPN	240237
Q-107	Transistor	244851
Q-108	Transistor	244851
Q-109	Transistor, PNP	247149
Q-110	Transistor, PNP	247149
Q-111	Transistor, NPN	242323
Q-112	Transistor, NPN	242323
Q-113	Transistor, NPN	242323
Q-114	Transistor, PNP	243009-28
Q-115	Transistor, PNP	243009-28
Q-120	Transistor, NPN	242323
R-101	Resistor	1-128182-1802
R-102	Resistor	1-128182-8892
R-103	Resistor	1-128182-5002
R-104		Not Used
R-105	Resistor	1-128182-4702
R-106	Resistor, Variable	243379-104
R-107	Resistor	5-115557-473
R-108	Resistor	5-115557-682
R-109	Resistor	1-128182-3902
R-110	Resistor	1-128182-6001

SYMBOL NO.	DESCRIPTION	PART NUMBER
R-111	Resistor	1-128182-1003
R-112	Resistor	1-128182-1002
R-113	Resistor	1-128182-1002
R-114	Resistor	1-128182-1002
R-115	Resistor	1-128182-1002
R-116	Resistor	5-115557-825
R-117	Resistor	1-128182-1003
R-118	Resistor, Variable	243379-203
R-119	Resistor	1-128182-1004
R-120	Resistor	5-115557-332
R-121	Resistor	5-115557-103
R-122	Resistor	5-115557-102
R-123	Resistor	1-128182-602
R-124	Resistor	1-128182-3502
R-125	Resistor, Variable	243379-203
R-126	Resistor, Variable	243379-203
R-127	Resistor	1-128182-1002
R-128	Resistor	1-128182-6802
R-129	Resistor	5-115557-102
R-130	Resistor	5-115557-103
R-131	Resistor	1-128182-1502
R-132	Resistor	1-128182-1502
R-133	Resistor	1-128182-1001
R-134	Resistor	1-128182-1001
R-135	Resistor	5-115557-222
R-136		Not Used
R-137	Resistor	50-128182-3030
R-138	Resistor	50-128182-3030
R-139		Not Used
R-140	Resistor	5-115557-222
R-141	Resistor	5-115557-390
R-142	Resistor	5-115557-390
R-143		Not Used
R-144		Not Used
R-145	Resistor	5-115557-103
R-146	Resistor	5-115557-102
R-147	Resistor	5-115557-102
R-148	Resistor	5-115557-911
R-149		Not Used
R-150		Not Used

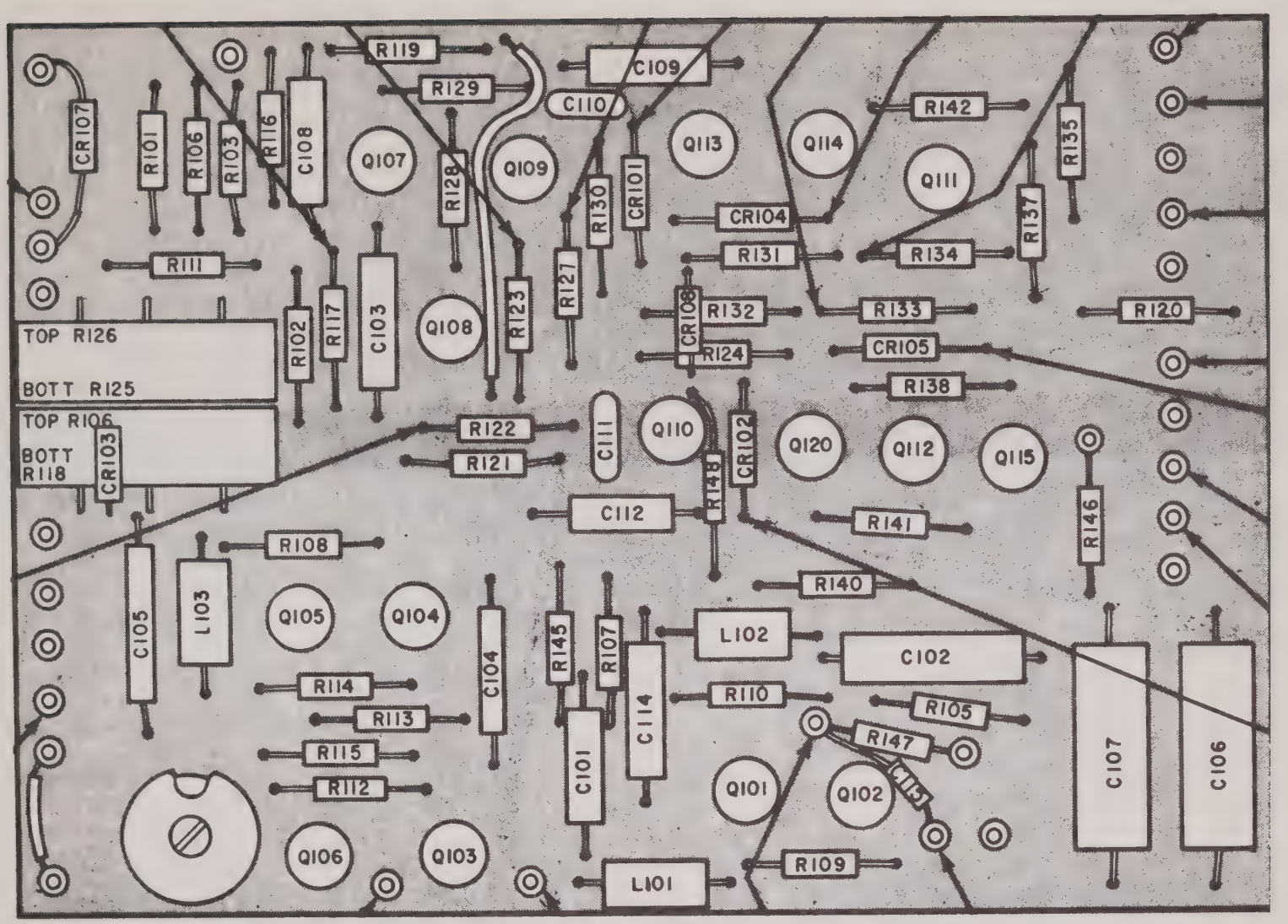

FIGURE 9-10
NETWORK ASM 848155

ELECTRICAL PARTS LIST
AMPLIFIER NETWORK ASM 848167 - FIGURE 9-11

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-101	Capacitor	10-125904-602
C-102	Capacitor	10-241145-304
C-103	Capacitor	10-241145-303
C-104	Capacitor	10-125904-203
C-105	Capacitor	10-125904-303
C-106	Capacitor	231922-356
C-107	Capacitor	231922-356
C-108	Capacitor	10-125904-102
C-109	Capacitor	10-125904-332
C-110	Capacitor	10-231854-271
C-111	Capacitor	10-231854-560
C-112	Capacitor	10-125904-332
C-113	Capacitor	10-241145-403
C-114	Capacitor	10-125904-603
C-115	Capacitor	240352-302
CR-101	Semiconductor	244311
CR-102	Semiconductor	244311
CR-103	Semiconductor	244311
CR-104	Semiconductor	244311
CR-105	Semiconductor	244311
CR-106	Semiconductor	244311
CR-107	Semiconductor	244311
CR-108	Semiconductor 1N816	231869
L-101	Reactor	243179
L-102	Reactor	243179
L-103	Reactor	243179
Q-101	Transistor	231884
Q-102	Transistor	243920-3
Q-103	Transistor, 2N1303	240236
Q-104	Transistor, 2N1302	240237
Q-105	Transistor, 2N1303	240236
Q-106	Transistor, 2N1302	240237
Q-107	Transistor	242323
Q-108	Transistor	242323
Q-109	Transistor	247149
Q-110	Transistor	247149
Q-111	Transistor	242323
Q-112	Transistor	242323
Q-113	Transistor	242323
Q-114	Transistor, 2N1186	243009-28
Q-115	Transistor, 2N1186	243009-28
Q-120	Transistor	242323
R-101	Resistor	1-128182-2752
R-102	Resistor	1-128182-4092
R-103	Resistor	1-128182-5002
R-105	Resistor	1-128182-1002
R-106	Resistor Asm	243580-910
R-107	Resistor	1-128182-4702
R-108	Resistor	5-115557-682
R-109	Resistor	1-128182-3902
R-110	Resistor	5-115557-123
R-111	Resistor	1-128182-1303

ELECTRICAL PARTS LIST
AMPLIFIER NETWORK ASM 848167 - FIGURE 9-11 (Continued)

SYMBOL NO.	DESCRIPTION	PART NUMBER
R-112	Resistor	1-128182-1002
R-113	Resistor	1-128182-1002
R-114	Resistor	1-128182-1002
R-115	Resistor	1-128182-1002
R-116	Resistor	5-115557-155
R-117	Resistor	1-128182-1003
R-118	Resistor Asm	243579-910
R-119	Resistor	1-128182-2504
R-120	Resistor	5-115557-332
R-121	Resistor	1-128182-4702
R-122	Resistor	5-115557-102
R-123	Resistor	1-128182-6802
R-124	Resistor	1-128182-3502
R-125	Resistor Asm	243577-910
R-126	Resistor Asm	662380
R-127	Resistor	1-128182-3502
R-128	Resistor	1-128182-6802
R-129	Resistor	5-115557-272
R-130	Resistor	1-128182-4702
R-131	Resistor	1-128182-1502
R-132	Resistor	1-128182-1502
R-133	Resistor	1-128182-1001
R-135	Resistor	5-115557-222
R-137	Resistor	50-128182-3030
R-138	Resistor	50-128182-3030
R-140	Resistor	5-115557-222
R-141	Resistor	5-115557-390
R-142	Resistor	5-115557-390
R-145	Resistor	5-115557-103
R-146	Resistor	5-115557-102
R-147	Resistor	5-115557-101
R-148	Resistor	5-115557-911
T-101	Transformer Asm	243590-910

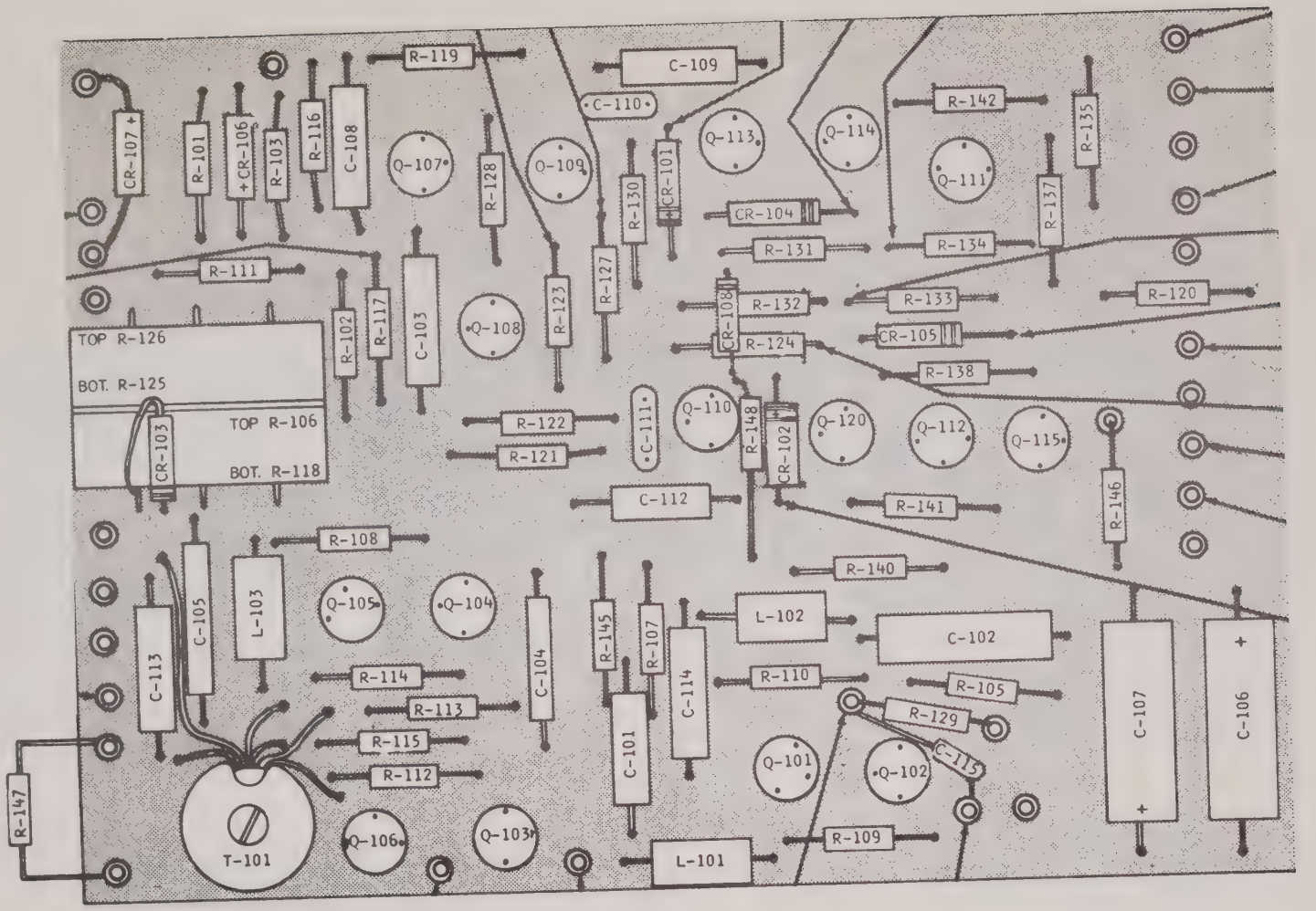

FIGURE 9-11
AMPLIFIER NETWORK ASM 848167

ELECTRICAL PARTS LIST
20 KC OSCILLATOR 442822 - FIGURE 9-12

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-401	Capacitor	243006-356
C-402	Capacitor, Fixed	231922-107
C-403	Capacitor, Fixed	10-125904-332
C-404	Capacitor, Fixed	10-125904-332
C-405	Capacitor, Fixed	10-125904-154
C-406	Capacitor, Fixed	10-125904-154
C-407	Capacitor	243006-356
C-408	Capacitor, Fixed	10-241145-143
CR-401	Semiconductor	240333
CR-402	Semiconductor	242853
CR-403	Semiconductor	242853
CR-404	Semiconductor	241133
CR-405	Semiconductor	249747
CR-406	Semiconductor	241133
CR-407	Semiconductor	231869
CR-408	Semiconductor	231869
CR-409	Semiconductor	231869
L-401	Coil, Adjustable	242009-1
Q-404	Transistor, PNP	240332
Q-405	Transistor, PNP	240332
Q-406	Transistor, PNP	231884
Q-407	Transistor, PNP	231884
Q-408	Transistor, PNP	231884
Q-409	Transistor, PNP	243920-3
R-401	Resistor	5-115557-273
R-402	Resistor	5-115558-470
R-403	Resistor	5-115557-272
R-404	Resistor	5-115557-181
R-405	Resistor	5-115557-181
R-406	Resistor, Variable	240539-501
R-407	Resistor	5-115558-152
R-408	Resistor	5-115557-333
R-409	Resistor	5-115557-333
R-410	Resistor	5-115557-103
R-411	Resistor	5-115557-103
R-412	Resistor	5-115557-331
R-413	Resistor	5-115557-222
R-414	Resistor	5-115557-472
R-415	Resistor, Variable	240539-202
R-416	Resistor	5-115557-680
R-417	Resistor	5-115557-120
R-418	Resistor	5-115557-331
R-419	Resistor	5-115557-562
R-420	Resistor	5-115557-123
T-401	Transformer	243188

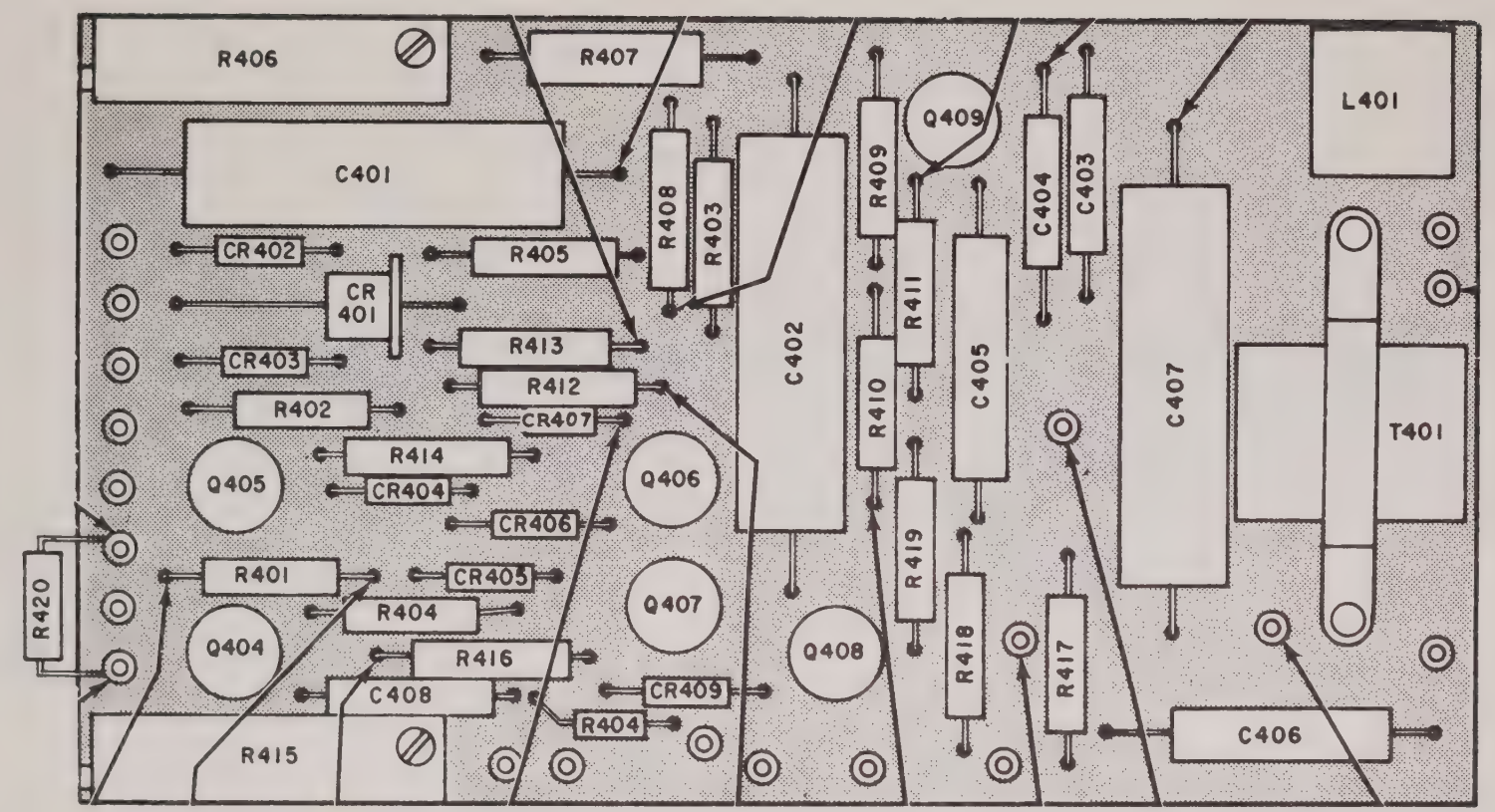

FIGURE 9-12
20 KC OSCILLATOR 442822

ELECTRICAL PARTS LIST
20 KC OSCILLATOR 846584 - FIGURE 9-13

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-401	Capacitor	243006-356
C-402	Capacitor	231922-107
C-403	Capacitor	10-125904-332
C-404	Capacitor	10-125904-332
C-405	Capacitor	10-125904-154
C-406	Capacitor	5-130488-503
C-407	Capacitor	243006-356
C-408	Capacitor	10-241145-143
CR-401	Semiconductor	240333
CR-402	Semiconductor	242853
CR-403	Semiconductor	242853
CR-404	Semiconductor, 1N751A	241133
CR-405	Semiconductor, 1N752A	249747
CR-406	Semiconductor, 1N751A	241133
CR-407	Semiconductor, 1N816	231869
CR-408	Semiconductor, 1N816	231869
CR-409	Semiconductor, 1N816	231869
L-401	Coil	242009-1
Q-404	Transistor, 2N1371	240332
Q-405	Transistor, 2N1371	240332
Q-406	Transistor, 2N1370	231884
Q-407	Transistor, 2N1370	231884
Q-408	Transistor, 2N1370	231884
Q-409	Transistor, 2N1193	243920-3
R-401	Resistor	5-115557-273
R-402	Resistor	5-115558-470
R-403	Resistor	5-115557-272
R-404	Resistor	5-115557-181
R-405	Resistor	5-115557-181
R-406	Resistor, Variable	240539-501
R-407	Resistor	5-115557-181
R-408	Resistor	5-115557-333
R-409	Resistor	5-115557-333
R-410	Resistor	5-115557-103
R-411	Resistor	5-115557-103
R-412	Resistor	5-115557-331
R-413	Resistor	5-115557-222
R-414	Resistor	5-115557-472
R-415	Resistor, Variable	240539-202
R-416	Resistor	5-115557-680
R-417	Resistor	5-115557-120
R-418	Resistor	5-115557-331
R-419	Resistor	5-115557-562
R-420	Resistor	5-115557-123
T-401	Transformer, 20KC	243188

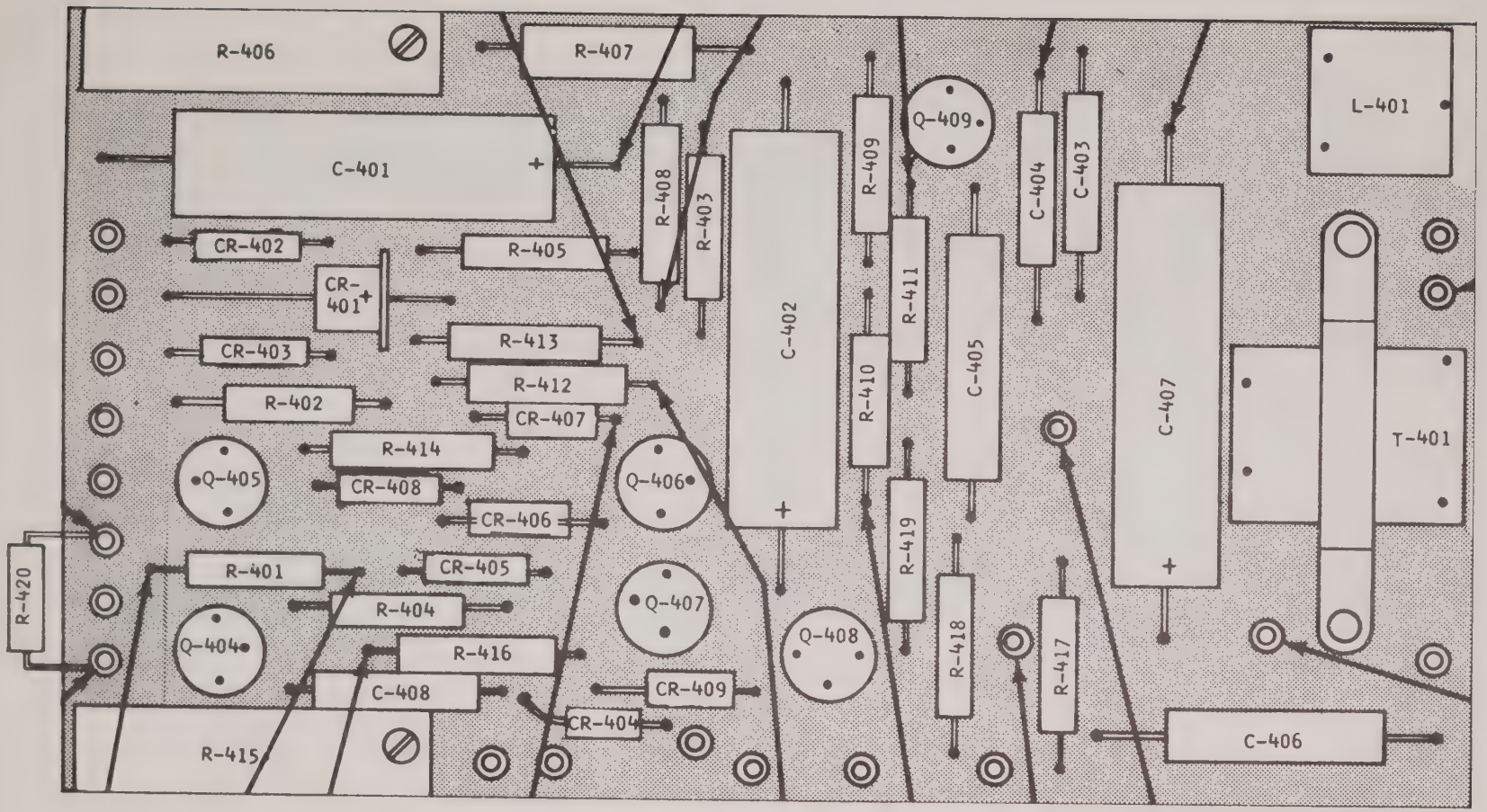

FIGURE 9-13
20 KC OSCILLATOR 846584

EXPLODED VIEW PARTS LIST
EVENT MARKER AMPLIFIER ASM MODEL 13-5281-01 - FIGURE 9-14

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Connector Plate Asm	761148	
2	Transformer	246110	T-802
3	Retainer, Fastener	242981	
4	Fastener, Positive Lock	243710	
5	Connector	232887	J-801
6	Handle	243675-1	
7	Transformer	246110	T-801
8	Bracket Asm	646164	
9	Relay	232003	K-802
10	Relay	232003	K-801
11	Chassis Subasm	649936	
12	Grommet	123108-62	
13	Grommet	123108-62	
14	Clamp, Cable	124804-2	
15	Connector	245075	J-802
16	Spacer	246759	
17	Spacer	246759	
18	Clamp, Cable	124804-2	
19	Clamp, Cable	124804-2	
20	Grommet	123108-62	
21	Plate, Key	248108	
22	Capacitor	243029-507	C-804
23	Plate, Capacitor	122228-1	
24	Network Asm, Amplifier (See Figure 9-15)	864122	
25	Plate, Capacitor	122228-1	
26	Capacitor	243029-507	C-803
27	Plate, Capacitor	122228-1	
28	Capacitor	243029-507	C-802
29	Plate, Capacitor	122228-1	
30	Capacitor	243029-507	C-801
31	Network Asm, Amplifier (See Figure 9-15)	864122	
32	Bracket Asm	646166	
33	Connector	243002	J-804
34	Support, Slide	242016	
35	Support, Slide	242016	
36	Spacer, Slide	248309	
37	Fuseholder	243054-2	
38	Fuse	102625-8	F-801
39	Fuse (spare)	102625-8	F-801
40	Capacitor	243029-507	C-808
41	Plate, Capacitor	122228-1	
42	Capacitor	243029-507	C-807
43	Plate, Capacitor	122228-1	
44	Capacitor	243029-507	C-806
45	Plate, Capacitor	122228-1	
46	Capacitor	243029-507	C-805
47	Plate, Capacitor	122228-1	
48	Grommet	123108-62	
49	Clamp, Cable	124804-2	
50	Spacer	246759	

EXPLODED VIEW PARTS LIST
EVENT MARKER AMPLIFIER ASM MODEL 13-5281-01 - FIGURE 9-14 (Continued)

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
51	Connector	245075	J-803
52	Clamp, Cable	124804-2	
53	Spacer	246759	
54	Relay	232003	K-804
55	Relay	232003	K-803
56	Grommet	123108-62	
57	Grommet	123108-62	
58	Network Asm, (See Figure 9-16)	746803	
59	Chassis Subasm		
60	Clamp, Cable	124804-2	
61	Spacer, Plate	248309	
62	Support, Slide	242016	
63	Support, Slide	242016	

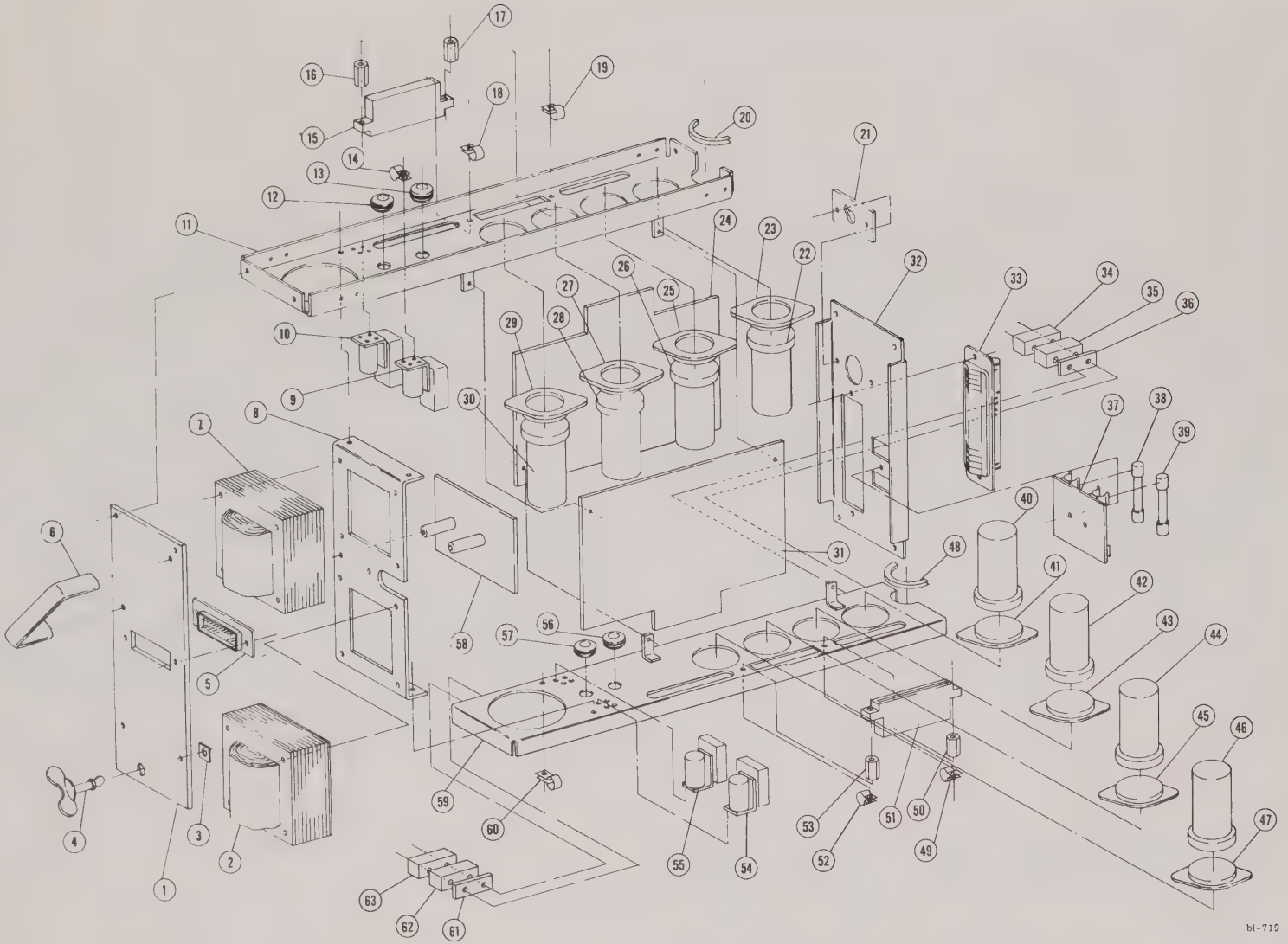

FIGURE 9-14
EVENT MARKER AMPLIFIER ASM MODEL 13-5281-01

ELECTRICAL PARTS LIST
AMPLIFIER ASM 864122 - FIGURE 9-15

SYMBOL NO.	DESCRIPTION	PART NUMBER
CR-801	Semiconductor	231887
CR-802	Semiconductor	231887
CR-803	Semiconductor	231887
CR-804	Semiconductor	231887
CR-805	Semiconductor	247106
CR-806	Semiconductor	231869
CR-807	Semiconductor	231869
CR-808	Semiconductor	5-244922-11
Q-801	Transistor	242323
Q-802	Transistor	247149
Q-803	Transistor	262804
R-801	Resistor, Variable	246108
R-802	Resistor	5-115557-183
R-803	Resistor	5-115557-222
R-804	Resistor	5-115557-273
R-805	Resistor	5-115557-822
R-806	Resistor	5-115557-104
R-807	Resistor	5-115557-564
R-808	Resistor	5-115557-392
R-809	Resistor	5-115557-100

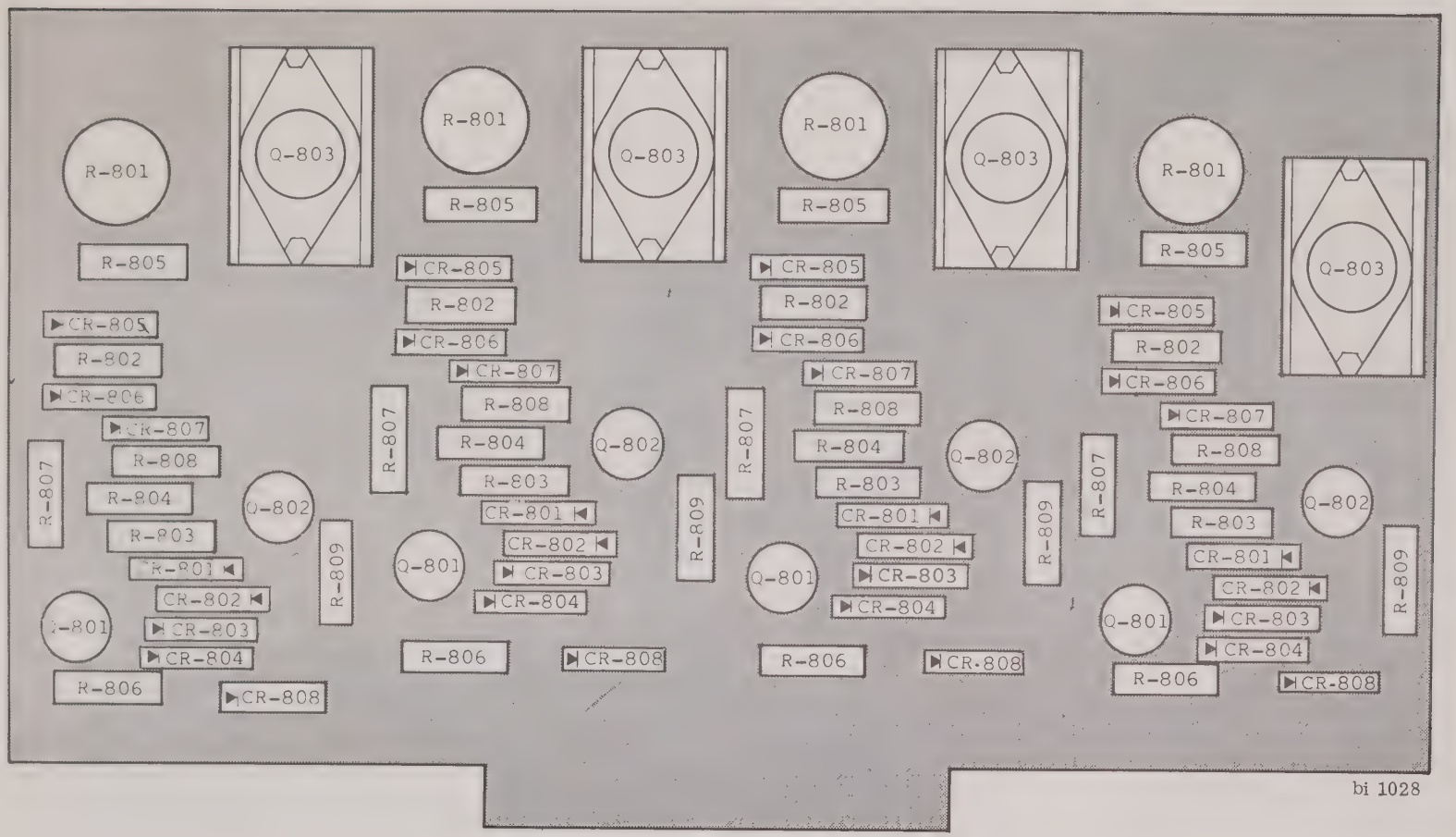

FIGURE 9-15
AMPLIFIER ASM 864122

ELECTRICAL PARTS LIST
NETWORK ASM 746803 - FIGURE 9-16

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-820	Capacitor	243685-107
C-821	Capacitor	243228-107
CR-820	Semiconductor	130198-1
CR-821	Semiconductor	130198-1
CR-822	Semiconductor	130198-1
CR-823	Semiconductor	243050
CR-824	Semiconductor	231869
CR-825	Semiconductor	231869
R-820	Resistor	5-115559-152
R-821	Resistor, Variable	241465
R-822	Resistor	5-115557-271
R-823	Resistor	5-119370-150

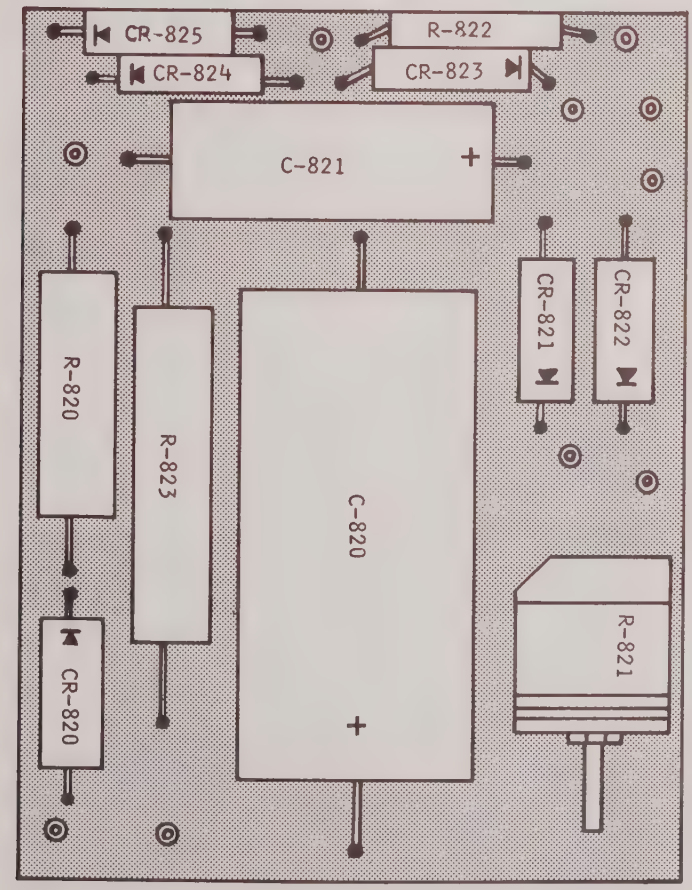

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FIGURE 9-16
NETWORK ASM 746803

EXPLODED VIEW PARTS LIST
CHART DRIVE ASSEMBLY 861577 - FIGURE 9-17

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Lever Asm	243611-910	
2	Bumper	243440	
3	Nut, Push-On	243856-1	
4	Spacer, Threaded	249862	
5	Bracket, Mtg	249854	
6	Screw, Shoulder	240132	
7	Plate Asm, Side LH	749880	
8	Bar, Mtg	348952	
9	Bushing, Adjustment	243602	
10	Bar, Event Marker Mtg	243588	
11	Kit Asm, Event Marker	11-2222-00	
12	Bar, Event Marker Connector	243559	
13	Pen Asm, Analog	11-2823-32	
14	Retainer, Capacitor	244546	
15	Panel Asm, Silk Screen	649955	
16	Penmotor, 80MM	442900-915	
17	Penmotor, 40MM	845077	
18	Pen Asm, Multimarker	RA-2821-20	
19	Penmotor, Multimarker	11-2109-80	
20	Component Asm, Elec. Drive Amp. (See Figure 9-18)	861408	
21	Plate Asm	749881	
22	Semiconductor Device, Diode	249164	CR-115
23	Bushing	263376	
24	Spring	244407	
25	Indicator Asm	644355	
26	Support, Spring	241840	
27	Spring	243457	
28	Arm Subasm	743913-910	
29	Screw	243461	
30	Post, Idler Gear Mtg	243736	
31	Bearing	232250-2	
32	Gear	243515	
33	Washer	243739	
34	Gear, Spur	243520	
35	Gear, Spur	243519	
36	Washer	116796	
37	Bearing	128721	
38	Disc Asm	643919-10	
39	Arm Asm	243610-910	
40	Arm Asm	743915-10	
41	Shaft	243469	
42	Collar	243443	
43	Hub Asm, Supply Roll	744015	
44	Shaft, Supply Roll	243445	
45	Spring, Positioning	243623	
46	Pad, Friction	243622	
47	Button, Detent	243507	
48	Pulley, Motor	243778	
49	Motor, A.C.	347415	B-101
49	Motor, A.C.	347248 (used on Mark 240-05, -15)	B-101

EXPLODED VIEW PARTS LIST
CHART DRIVE ASSEMBLY 861577 - FIGURE 9-17 (Continued)

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
49	Motor, A.C.	349087 (used on Mark 240-04, -14)	B-101
49	Motor, A.C.	363466 (used on Mark 240-06, -16)	B-101
50	Bracket, Mtr Mounting	346884	
51	Impeller, Fan	244076	
52	Bar Asm, Mtr Mounting	661046	
53	Bar, Mtr Mounting	243494	
54	Bar, Support	243495	
55	Post, Mounting	243583	
56	Transmission Asm	12-2151-16	
56	Transmission Asm	RC-2148-16 (used on Mark 240-05, -15, -06, -16)	
56	Transmission Asm	12-2151-16 (used on Mark 240-04, -14)	
57	Pulley Asm	643785-10	
57	Pulley Asm	644218 (used on Mark 240-04, -14)	
58	Belt Timing	243542-1	
59	Roll, Drive	343509	
60	Chute, Paper	343732	
61	Deflector, Paper	249668	
62	Table, Asm (See Figure 9-20)	843825-10	
63	Ink Supply Asm (See Figure 9-21)	844245	
63	Ink Supply Asm	863689 (used on Mark 240-06, -16)	
63	Ink Supply Asm	863344 (used on Mark 240-04, -14)	
63	Ink Supply Asm	863071 (used on Mark 240-05, -15)	
64	Packing, Preformed	232780-4	
65	Manifold Asm (See Figure 9-22)	861867	
66	Bolt, Shoulder	241838	
67	Shaft Asm, Supply Roll	744012	
68	Pin, Grooved	3-119820-709	
69	Not Used		
70	Capacitor	243091-505	C-107
70	Motor Start Capacitor (used with Motor 347415)	243091-505	C-107
70	Motor Start Capacitor (used with Motor 347248)	243091-605 (used on Mark 240-05, -15)	C-107
70	Motor Start Capacitor (used with Motor 349087)	263395-205 (used on Mark 240-04, -14)	C-107
70	Motor Start Capacitor (used with Motor 363466)	263890-505 (used on Mark 240-06, -16)	C-107
71	Connector	130168	J-110

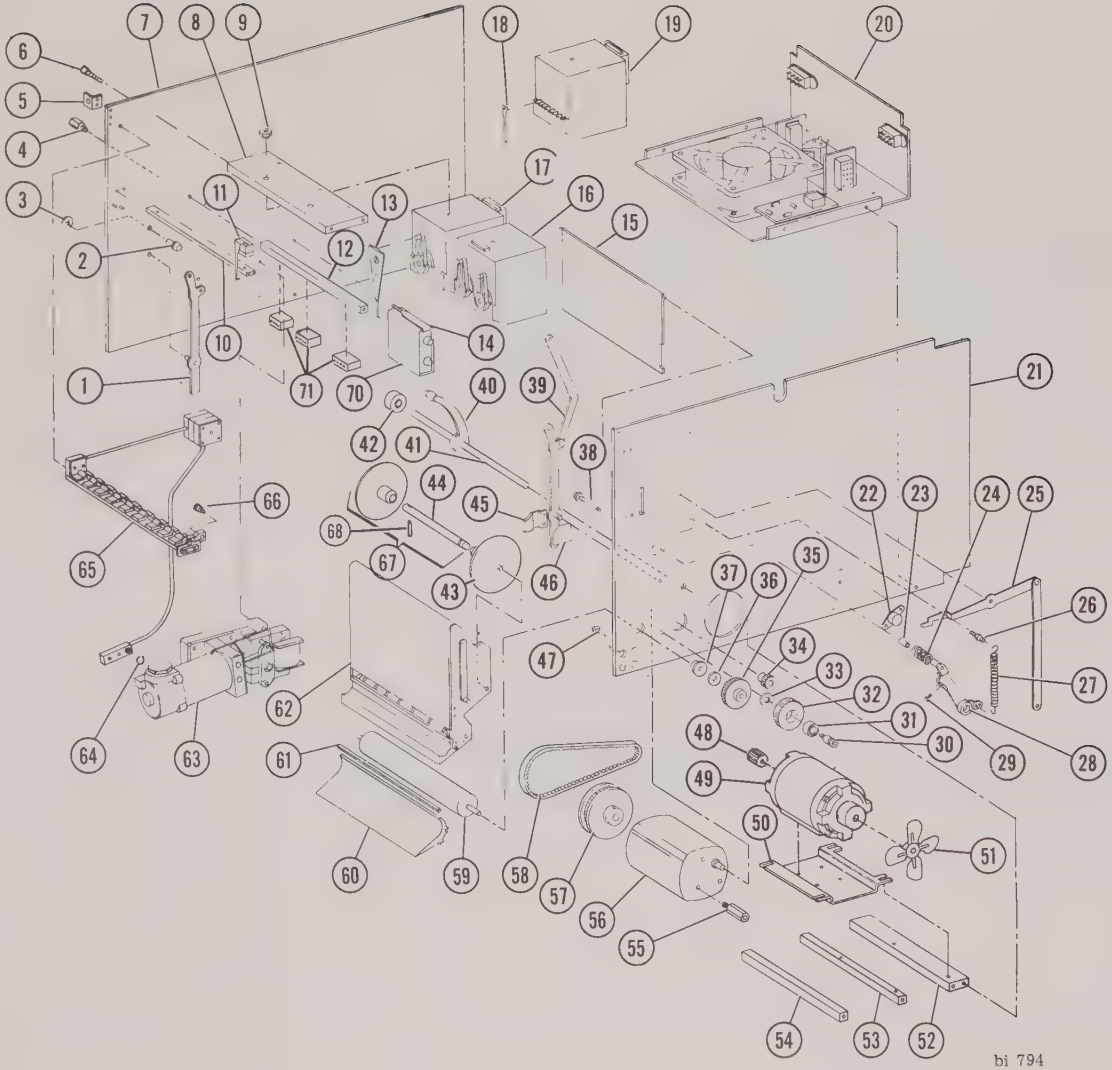

FIGURE 9-17
CHART DRIVE ASM 861577

EXPLODED VIEW PARTS LIST
COMPONENT ASM, 861408 - FIGURE 9-18

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Fan	244887	B-103
2	Connector and Relay Asm	761206	
	Consists of: (2) Connector	9-247923-15	J-103 A & B
	(1) Relay	263014	K-101
3	Bracket	261198	
4	Bracket Asm, Relay	663318	
5	Board, Terminal	265814-10	TB-104
6	Semiconductor	130198-1	CR-101
7	Connector	130168	J-109
8	Semiconductor	130198-1	CR-102
9	Semiconductor	130198-1	CR-103
10	Connector	130168	J-111
11	Semiconductor	130198-1	CR-104
12	Semiconductor	130198-1	CR-105
13	Connector	130168	J-113
14	Semiconductor	130198-1	CR-106
15	Board, Terminal	1-216886-318	TB-106
16	Switch	240613	S-107
17	Socket, Transistor	262624	
18	Switch	128004	S-106
19	Switch Asm (See Figure 9-19)	761459	
20	Spacer	1-105704-1	
21	Marker, Strip	1-234358-5	
22	Board, Terminal	267050-5	TB-101
23	Board, Terminal	265814-7	TB-102
24	Board, Terminal	265814-5	TB-103
25	Semiconductor	130198-1	CR-109
26	Semiconductor	130198-1	CR-110
27	Semiconductor	130198-1	CR-113
28	Semiconductor	130198-1	CR-114
29	Chassis Asm	749920	
30	Switch	240613	S-108

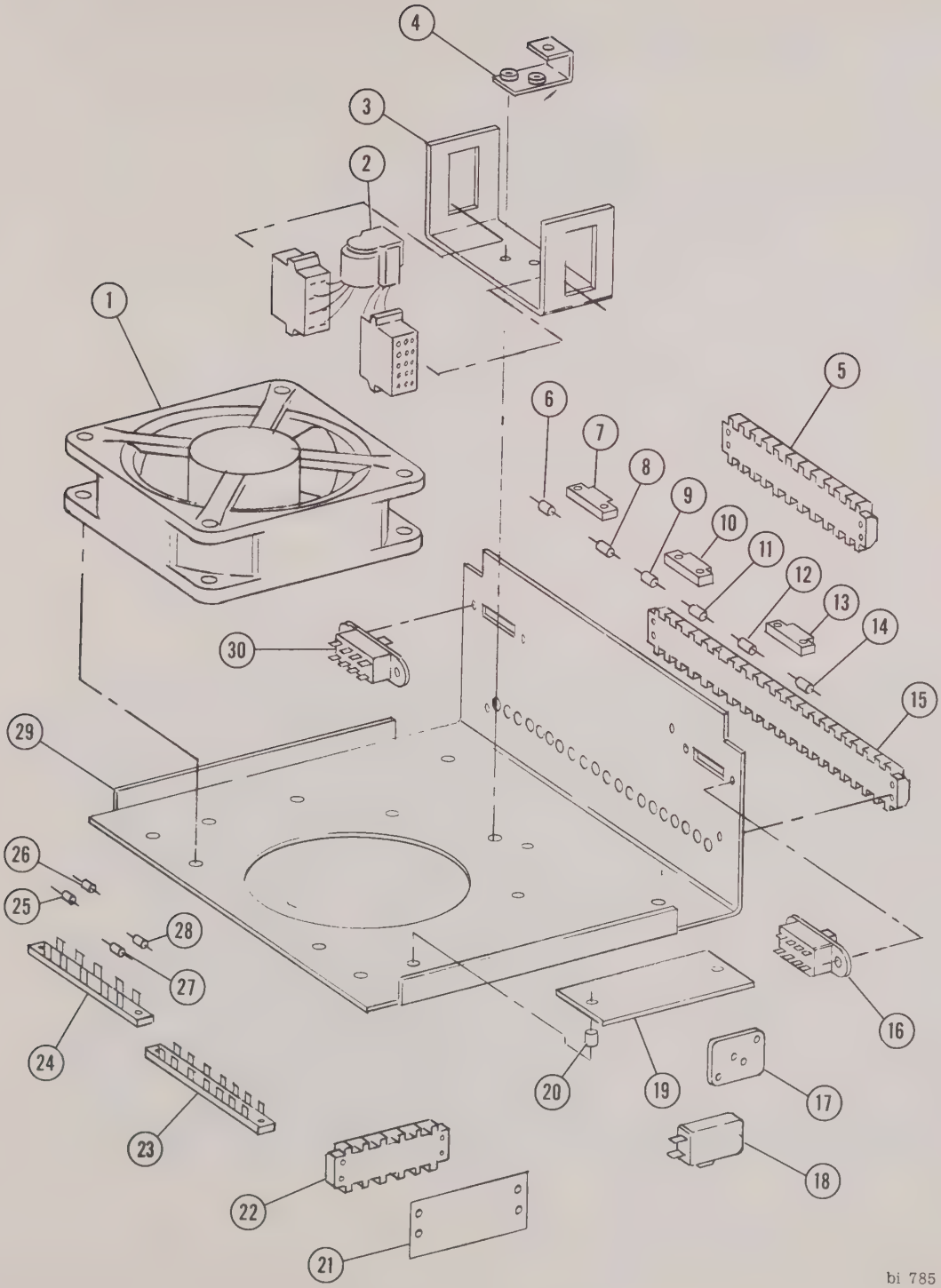

FIGURE 9-18
COMPONENT ASM 861408

ELECTRICAL PARTS LIST
SWITCH ASSEMBLY, MODEL 761459 - FIGURE 9-19

SYMBOL NO.	DESCRIPTION	PART NUMBER
C-301	Capacitor	10-241145-104
CR-301	Semiconductor	249165-1
CR-302	Semiconductor	249165-1
CR-303	Semiconductor	249165-1
CR-304	Semiconductor	249165-1
CR-305	Semiconductor	130198-1
K-301	Relay	266414
R-301	Resistor	5-115557-153

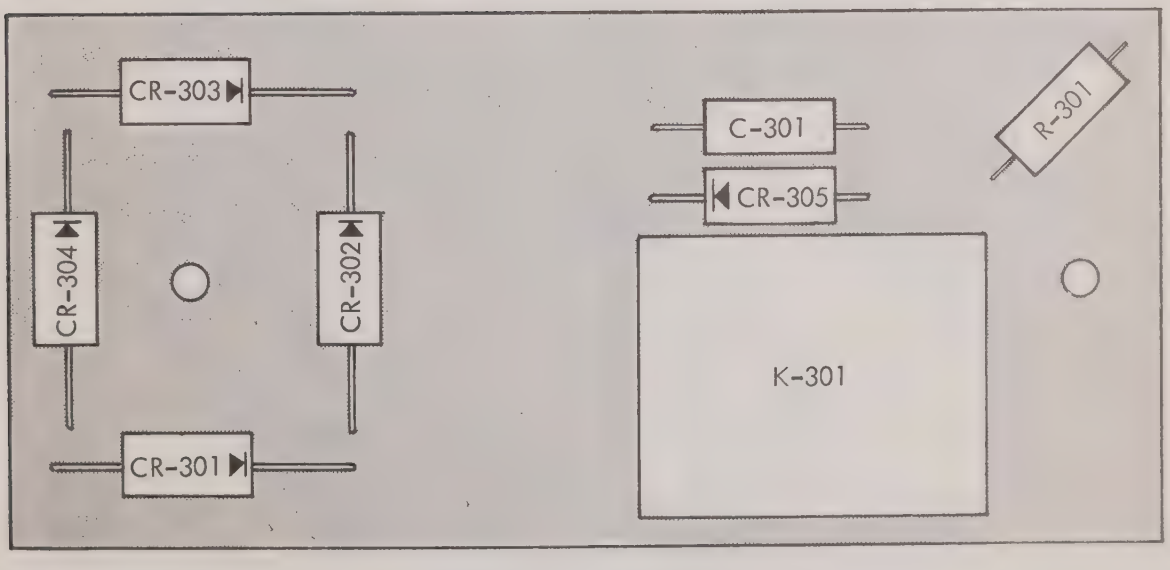

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FIGURE 9-19
SWITCH ASSEMBLY MODEL 761459

EXPLODED VIEW PARTS LIST
WRITING TABLE ASSEMBLY 843825 - FIGURE 9-20

ITEM NO.	DESCRIPTION	PART NUMBER
1	Support Asm, Left	343617-910
2	Pin, Dowel	2-214148-102
3	Bar, Writing	343650-910
4	Paper Release Asm	743807-10
5	Support Asm, Right	343616-910
6	Bearing	1-210761-6
7	Roll, Pressure	343620
8	Pin, Roll	4-112468-9
9	Not Used	
10	Pull Bar Asm	649667
11	Packing, Preformed	243867-1
12	Pin, Spring	129384-9

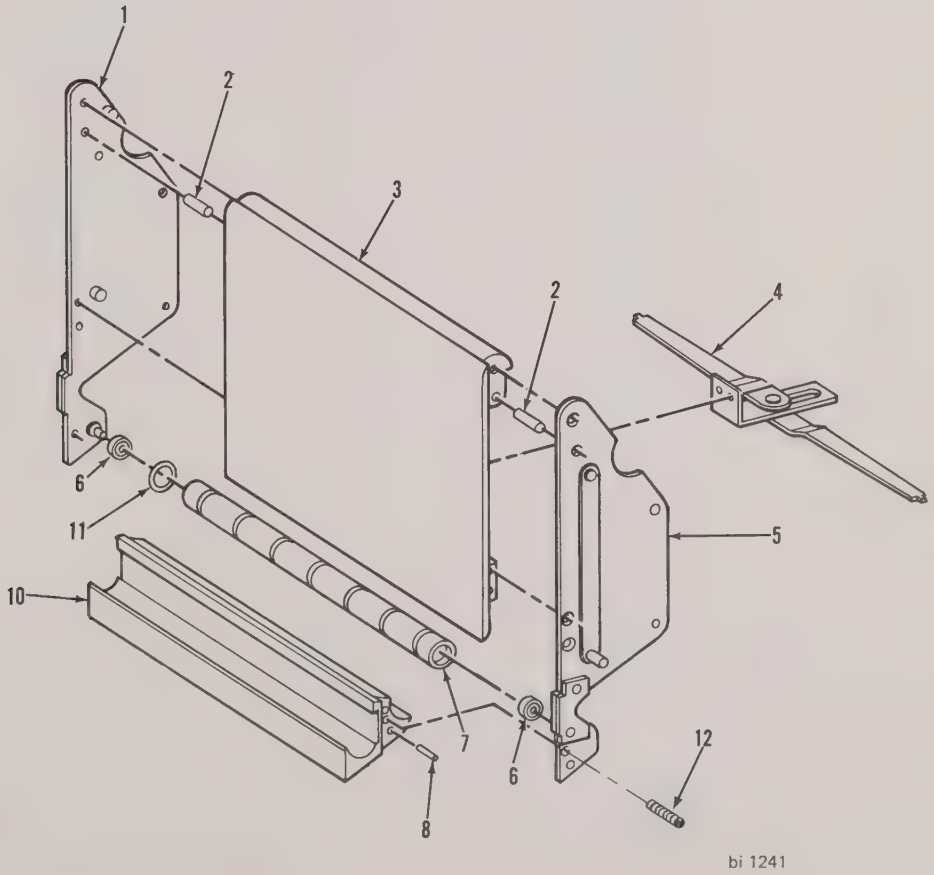

FIGURE 9-20
WRITING TABLE ASSEMBLY 843825

EXPLODED VIEW PARTS LIST
INK SUPPLY ASSEMBLY 844245 - FIGURE 9-21

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Motor Asm, Ink Pump	866010 (used on Mark 240-10)	B-703
1	Motor, A.C. Gear Head, 50 Hz	346052 (used on Mark 240-15)	B-703
1	Motor, A.C. Gear Head, 400 Hz	863440 (used on Mark 240-14)	B-703
1	Motor, A.C. Gear Head, 50 Hz, 230V	263632 (used on Mark 240-16)	B-703
2	Plate Mtg	243937	
3	Plate Mtg	243936	
4	Pointer	247807	
5	Guide, Pointer	247808	
6	Pin, Roll	4-112468-19	
7	Gear, Spur	243826	
8	Bearing, Roller	232250-7	
9	Ring, Retaining	9-227070-3	
10	Guide, Gear Rack	243938	
11	Pin, Straight	240161-424	
12	Cylinder Asm, Ink	644223	
13	Gear, Rack	243828	
14	Piston	243821	
15	Diaphragm, Valve	243857	
16	Cap, Piston	243827	
17	Spring, Retainer	244220	
18	Chamber, Ink	444213	
19	Valve	244109	
20	Insert	344593	
21	Packing, Preformed	232780-7	
22	Screw, Cap	244592	
23	Stud, Continuous Thread	243939	

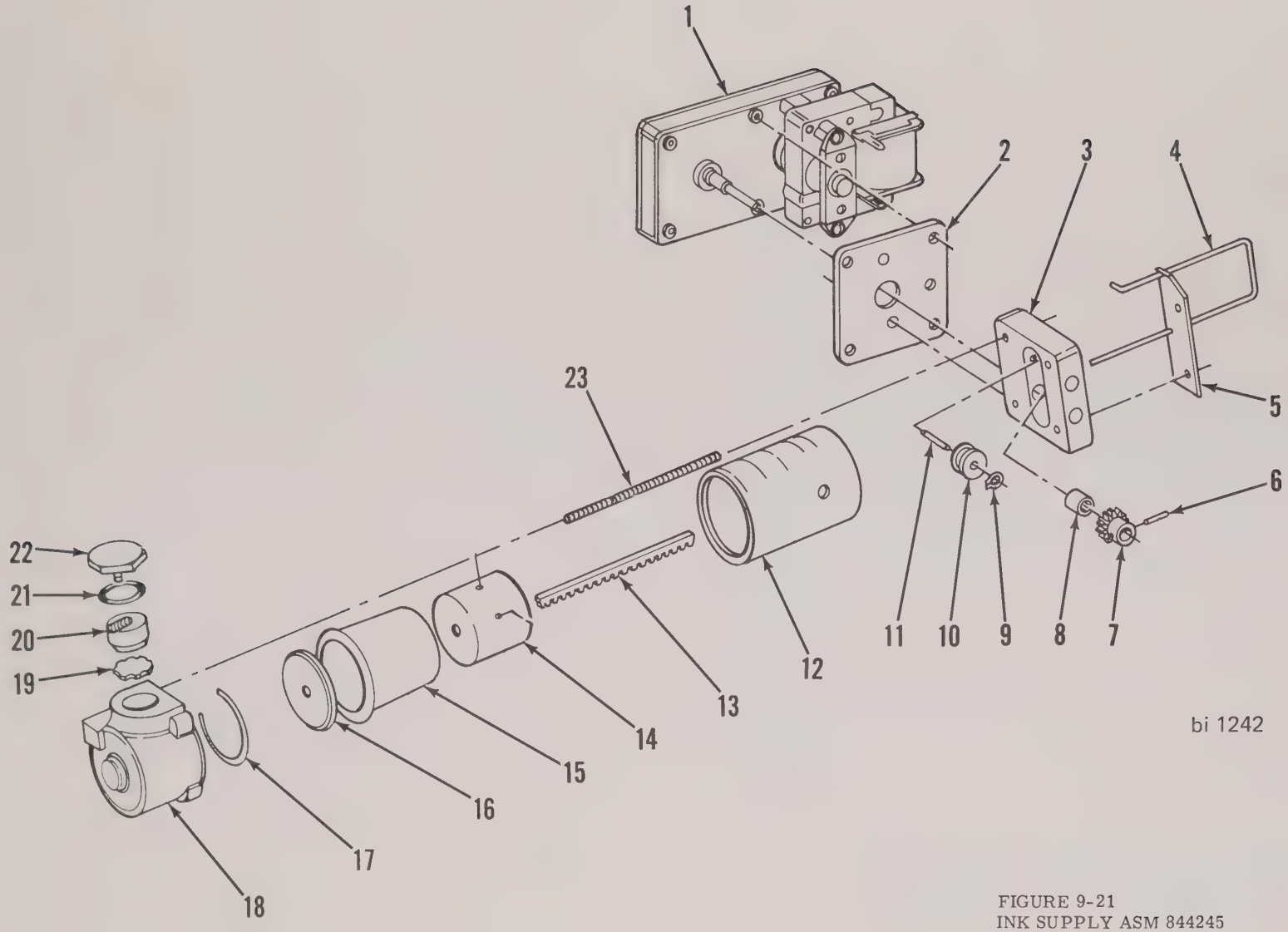

FIGURE 9-21
INK SUPPLY ASM 844245

EXPLODED VIEW PARTS LIST
MANIFOLD ASM 844361 - FIGURE 9-22

ITEM NO.	DESCRIPTION	PART NUMBER
1	Tube Asm	844662
2	Packing, Preformed	232780-2
3	Valve Body	344660
4	Check Valve	244655
5	Spring	244657
6	Packing, Preformed	232780-7
7	Bellows Asm	744679
8	Spring	244688
9	Cover	244673
10	Cap	241837
11	Packing, Preformed	232780-4
12	Manifold Support	242421
13	Manifold Arm	241836
14	Screw, Socket Head	20-119918-4006
15	Retainer, Seal	241845
16	Packing, Preformed	232780-4
17	Lockwasher	1-216741-420

NOTE: Items 2 thru 9 may be ordered as an assembly as Part Number 666895

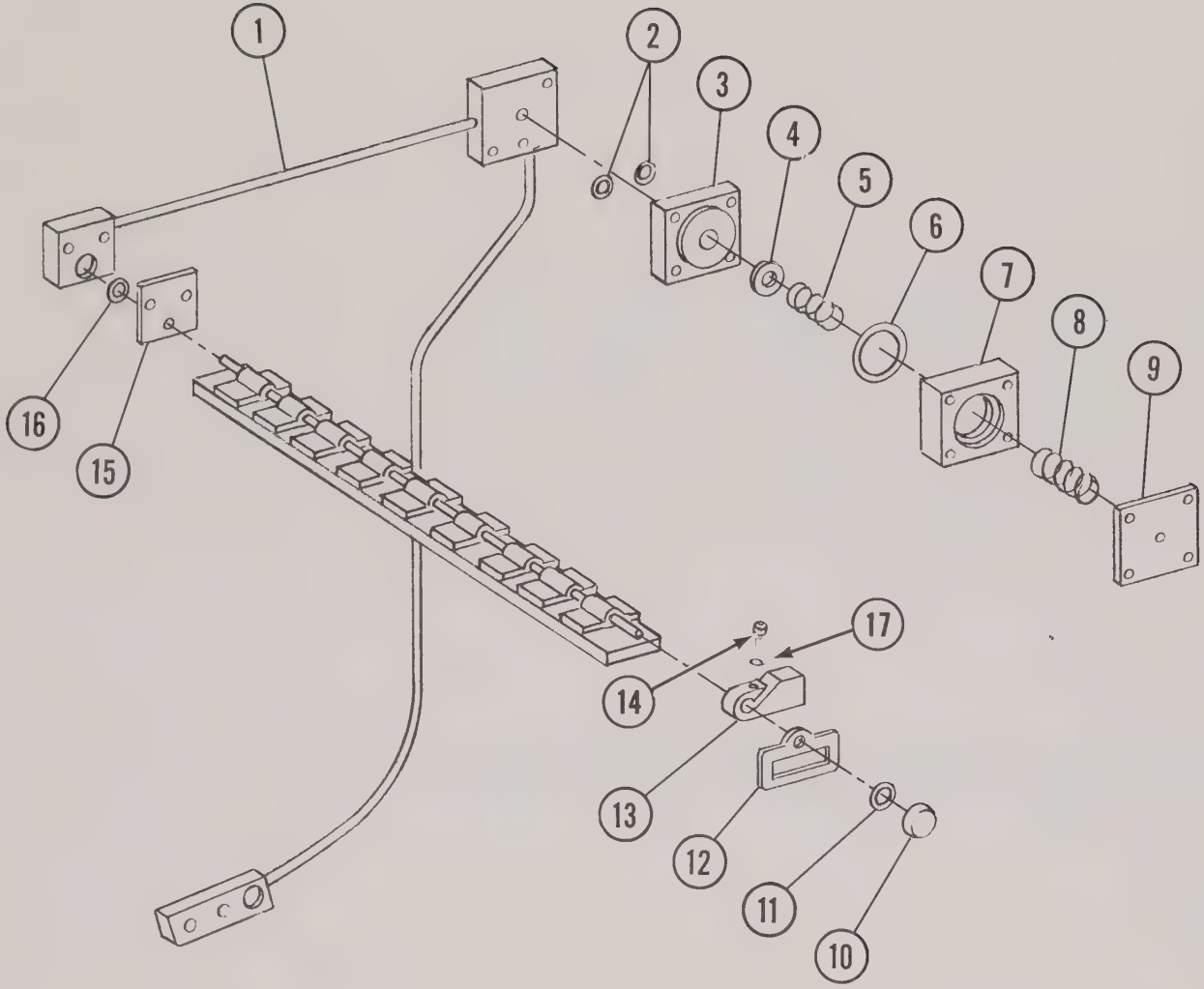

FIGURE 9-22
MANIFOLD ASM 844361

EXPLODED VIEW PARTS LIST
SHELF ASM 862810 - FIGURE 9-23

ITEM NO.	DESCRIPTION	PART NUMBER	SYMBOL NO.
1	Button, Push	246552-1	
2	Switch, Pushbutton	446357	S-109
3	Bracket, Lampholder, RT	249939	
4	Lampholder	232135	
5	Lamp, Fluorescent	249960-1 (LAMP F4T5/CW)	DS-102
6	Bracket, Lampholder, LT	249938	
7	Ballast	231962	
8	Board, Terminal	265814-5	TB-103
9	Starter	231964	S-105
10	Socket, Starter	231965	
11	Support, Amplifier	248546	
12	Plate Asm, Support Pre-Amp	762784	
13	Bracket, Support Pre-Amp	348974	
14	Pin, Shoulder	243213	
15	Bracket Asm	749926	
16	Connector Asm, Input	231977-910	
17	Connector Asm, Input	231977-910	
18	Connector	123837	J-106/J-117
19	Connector	123837	J-108/J-119
20	Shelf Subasm	763229	
21	Panel Asm	762761	
22	Bezel	448550	
23	Lamp	1-241774-8	DS-101
24	Switch, Toggle	234028	S-101
25	Switch, Push	231968	S-102
26	Switch, Push	231968	S-103
27	Socket, Lamp	248809	
28	Switch, Toggle	234028	S-104

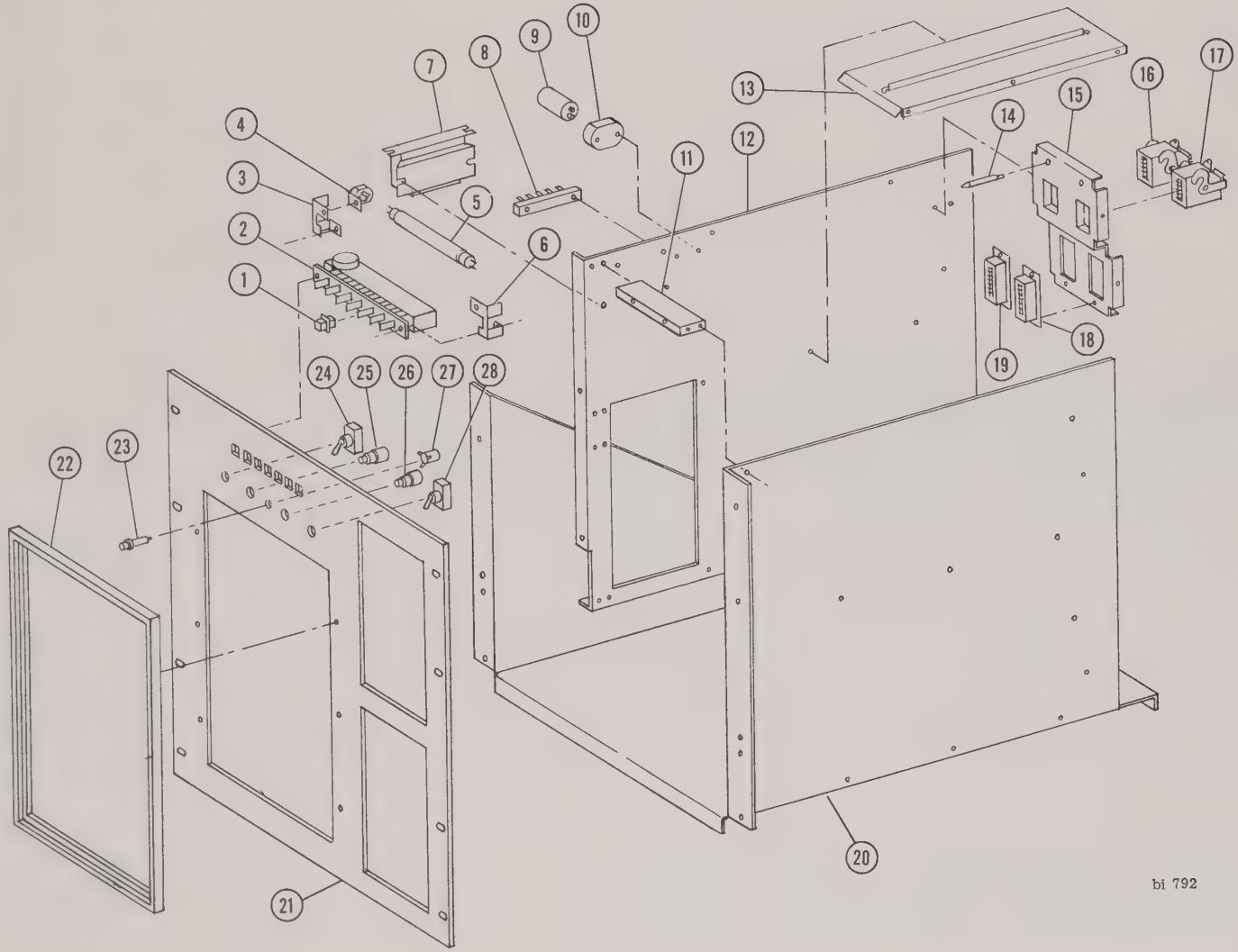

FIGURE 9-23
SHELF ASM 862810

EXPLODED VIEW PARTS LIST
CHART TAKEUP ASM 11-6402-00 - FIGURE 9-24

ITEM NO.	DESCRIPTION	PART NUMBER
1	Screw, Shouldered	243737
2	Spring, Flat	111360-3
3	Washer	243950
4	Plate, Cover Left	343722-1
5	Ring, Retaining	10-127657-6
6	Washer, Plain	128967-2
7	Arm, Takeup Left	343770-1
8	Bearing, Ball	1-210761-7
9	Shaft Subasm	644026
10	Collar, Shaft	243740
11	Pin, Roll	4-112468-14
12	Bearing, Ball	1-210761-7
13	Spring, Helical	243862
14	Shaft, Shouldered	243741
15	Plate, Ident	243192
16	Arm, Takeup	343768-1
17	Pin, Roll	4-112468-8
18	Pulley	343686
19	Spring, Belt	243838
20	Plate, Cover	243720-1
2		
21	Knob	243688
22	Pulley, Driven	243738
23	Packing, Preformed	243844-1
24	Retainer, Bearing	243696

FIGURE 9-24
CHART TAKEUP ASM 11-6402-00

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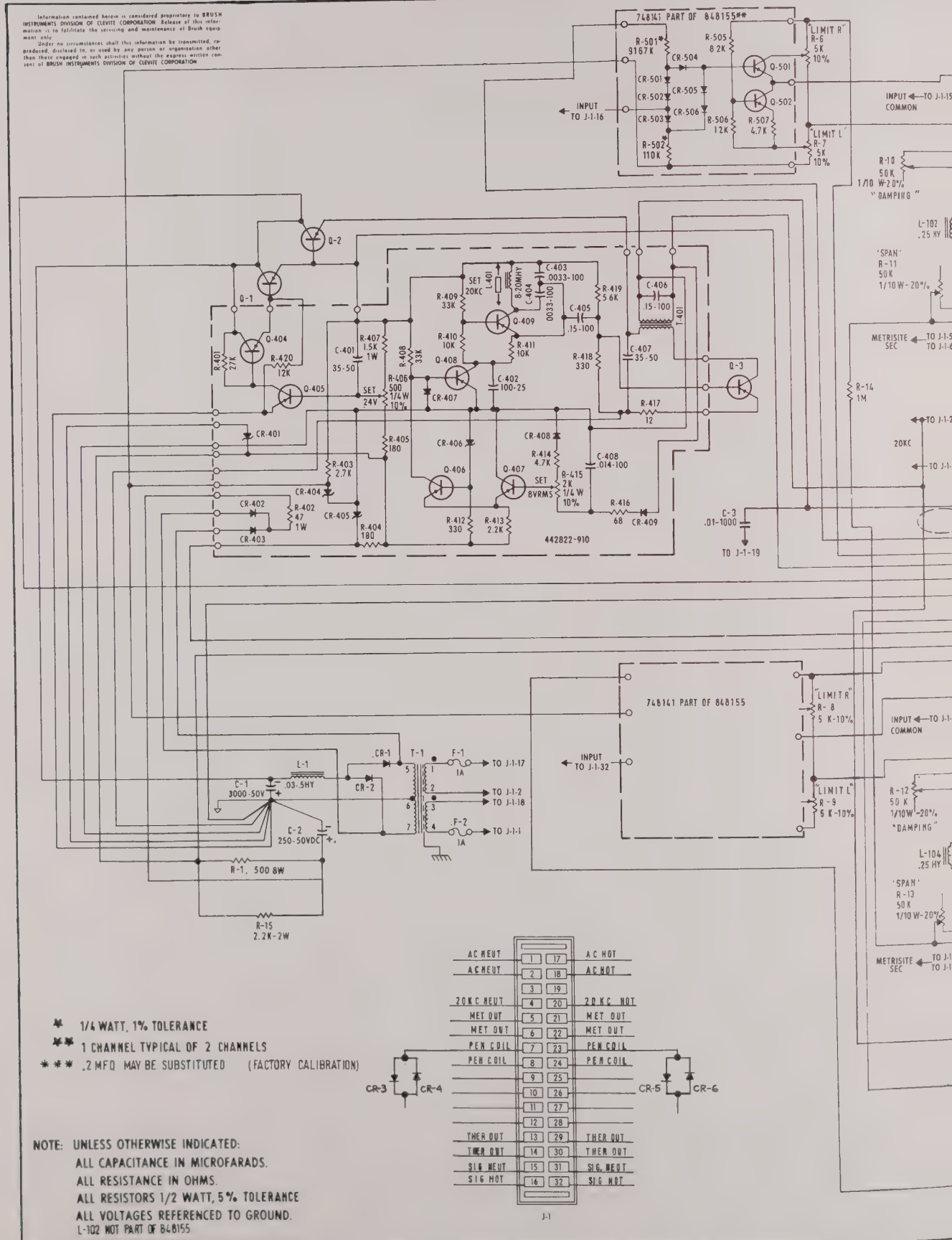


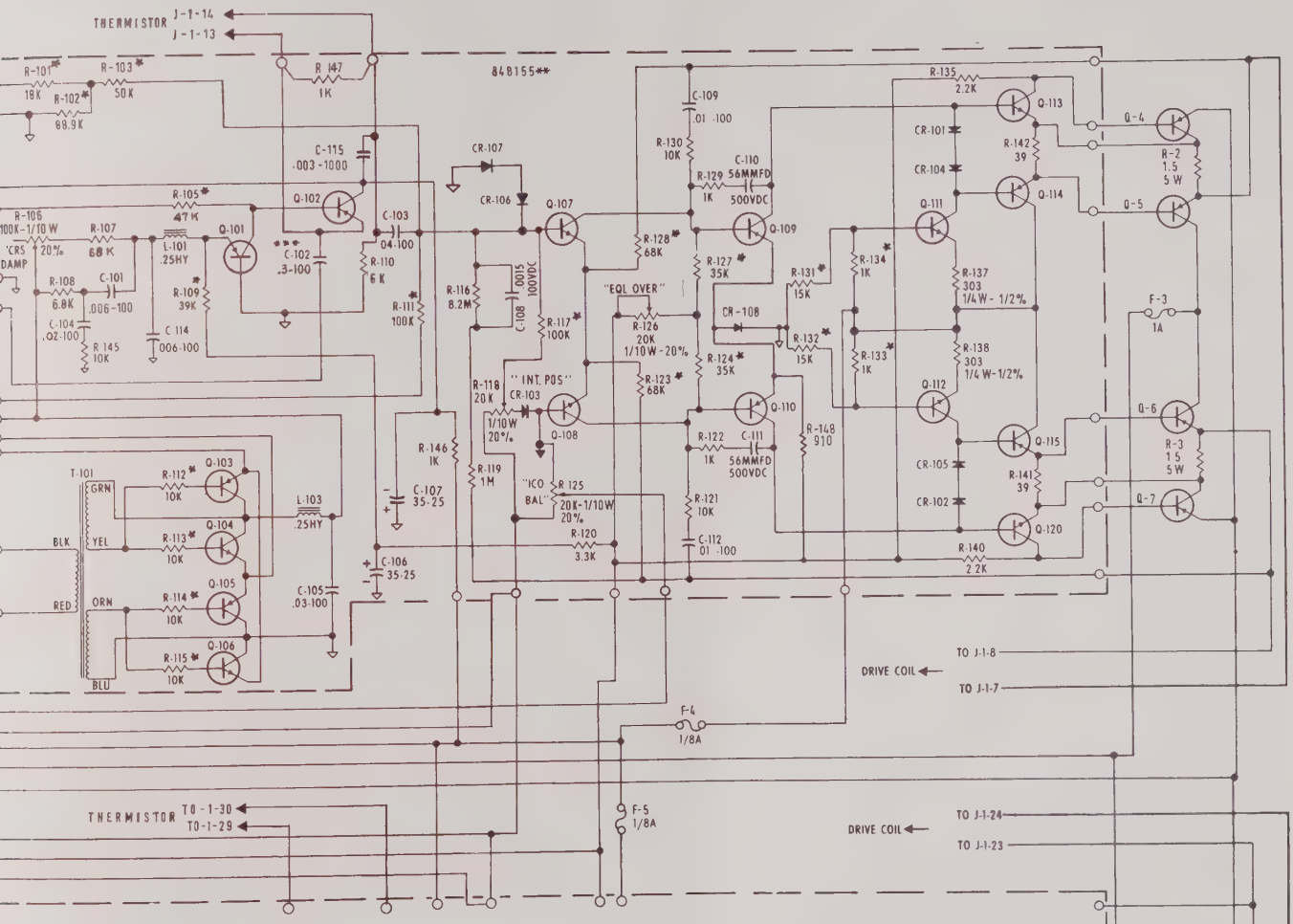
* 1/4 WATT, 1% TOLERANCE

** 1 CHANNEL TYPICAL OF 2 CHANNELS

*** .2 MFD MAY BE SUBSTITUTED (FACTORY CALIBRATION)

NOTE: UNLESS OTHERWISE INDICATED:
ALL CAPACITANCE IN MICROFARADS.
ALL RESISTANCE IN OHMS.
ALL RESISTORS 1/2 WATT, 5% TOLERANCE
ALL VOLTAGES REFERENCED TO GROUND.
L-102 NOT PART OF 848155

REV. M-1



848155

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES = ±½° .XX = ± .015 SURFACE = √ .XXX = ± .005 MATL. ADD FIN. FIRST USE	DR. BY LOWAK DATE 8/24/64 CH. BY DATE APPD. WEK DATE 8-31-64	NAME SCHEMATIC, 15-5221-11 DRIVE AMPLIFIER	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND, OHIO, U.S.A.
		CODE IDENT. 96795 ISSUE CODE G SCALE ~ WT	DWG. NO. 448144

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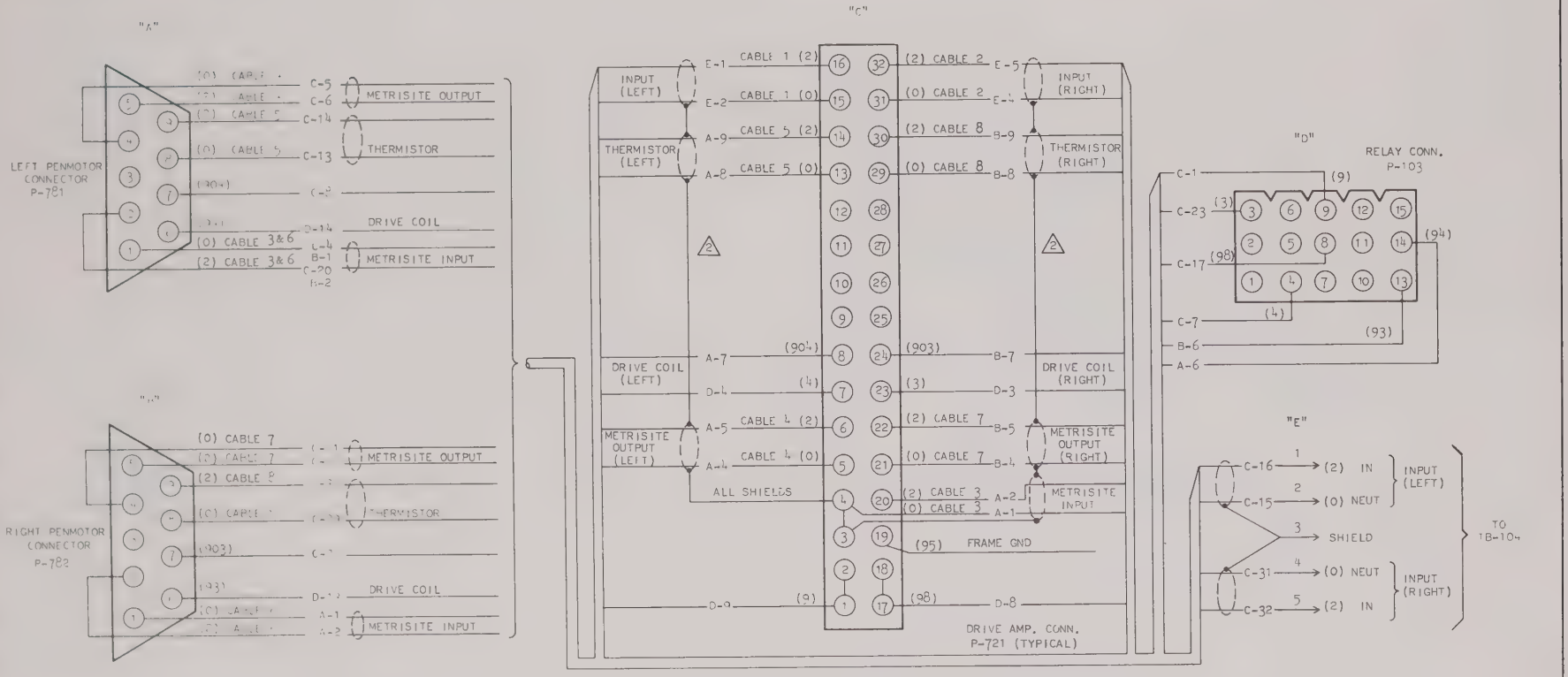

ALL WIRE COLORS IN EIA CODE ARE SHOWN IN PARENTHESES ( ).

2 JUMPERS SHOWN BETWEEN CABLE SHIELDS ARE PRODUCED BY DRAIN WIRES NOT EXTERNAL CONNECTIONS.

VIEWED FROM WIRING SIDE.

BY	DATE	NAME	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP CLEVELAND OHIO U.S.A.
DR Baltz	6-15	DIAGRAM, WIRING MODEL NO. 11-2291-20	DWG 262018
CH		CODE IDENT	ISSUE G
APP			SHEET 1 OF 1

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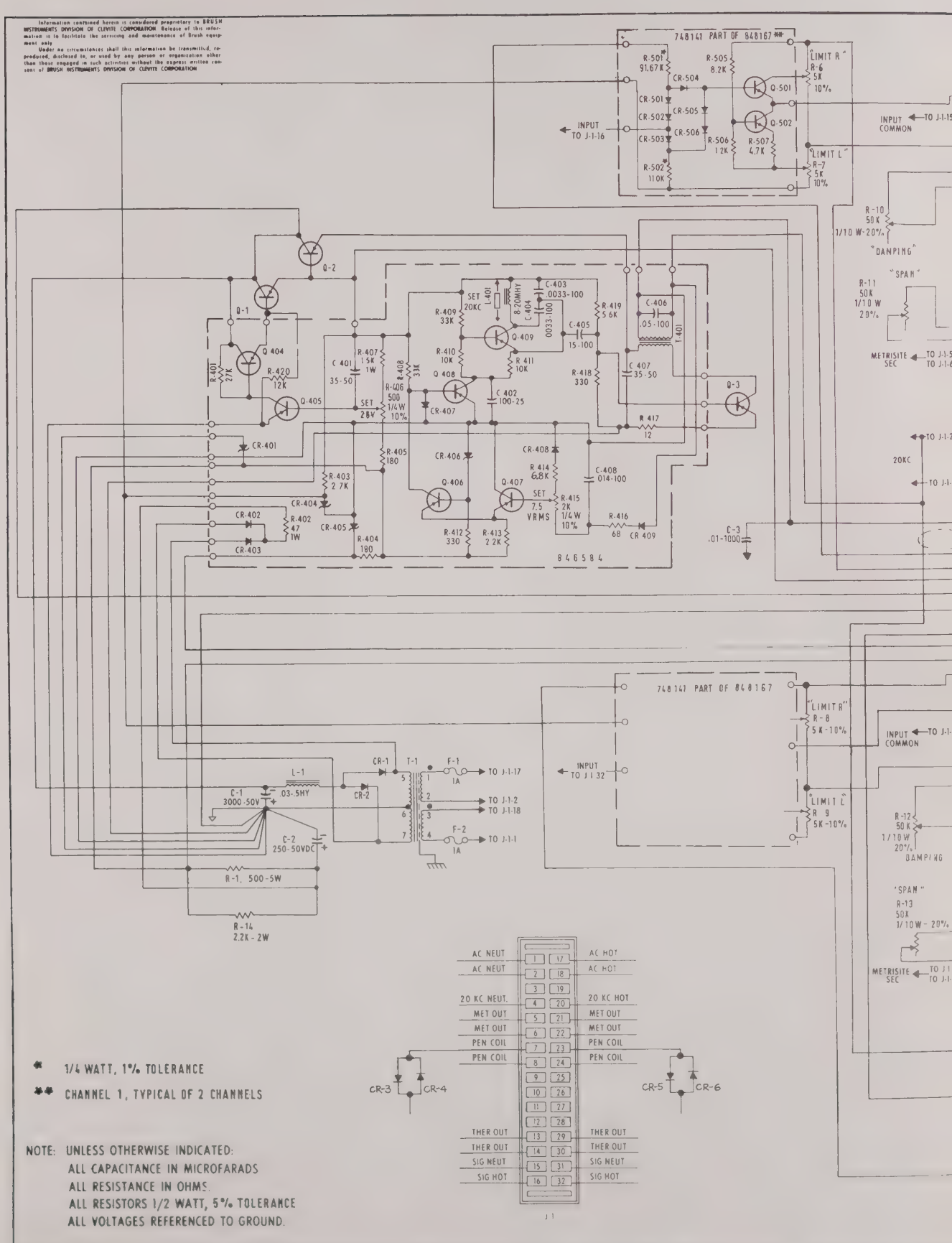
Under no circumstances shall this information be transmitted, reproduced, disclosed to, or used by any person or organization other than those engaged in such activities without the express written consent of BRUSH INSTRUMENTS DIVISION OF CLEVITE CORPORATION

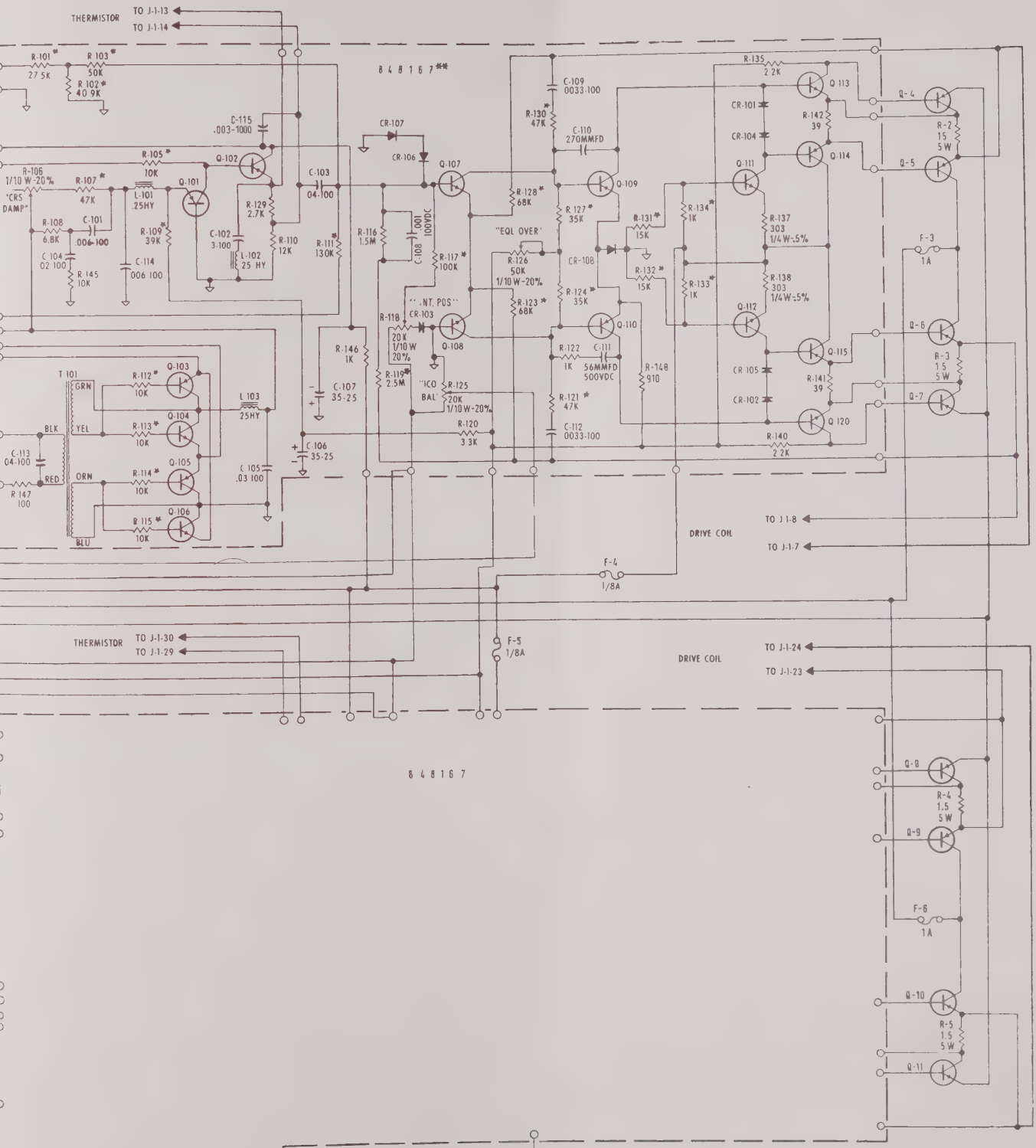


* 1/4 WATT, 1% TOLERANCE

** CHANNEL 1, TYPICAL OF 2 CHANNELS

NOTE: UNLESS OTHERWISE INDICATED:
ALL CAPACITANCE IN MICROFARADS
ALL RESISTANCE IN OHMS.
ALL RESISTORS 1/2 WATT, 5% TOLERANCE
ALL VOLTAGES REFERENCED TO GROUND.

REV. H-1

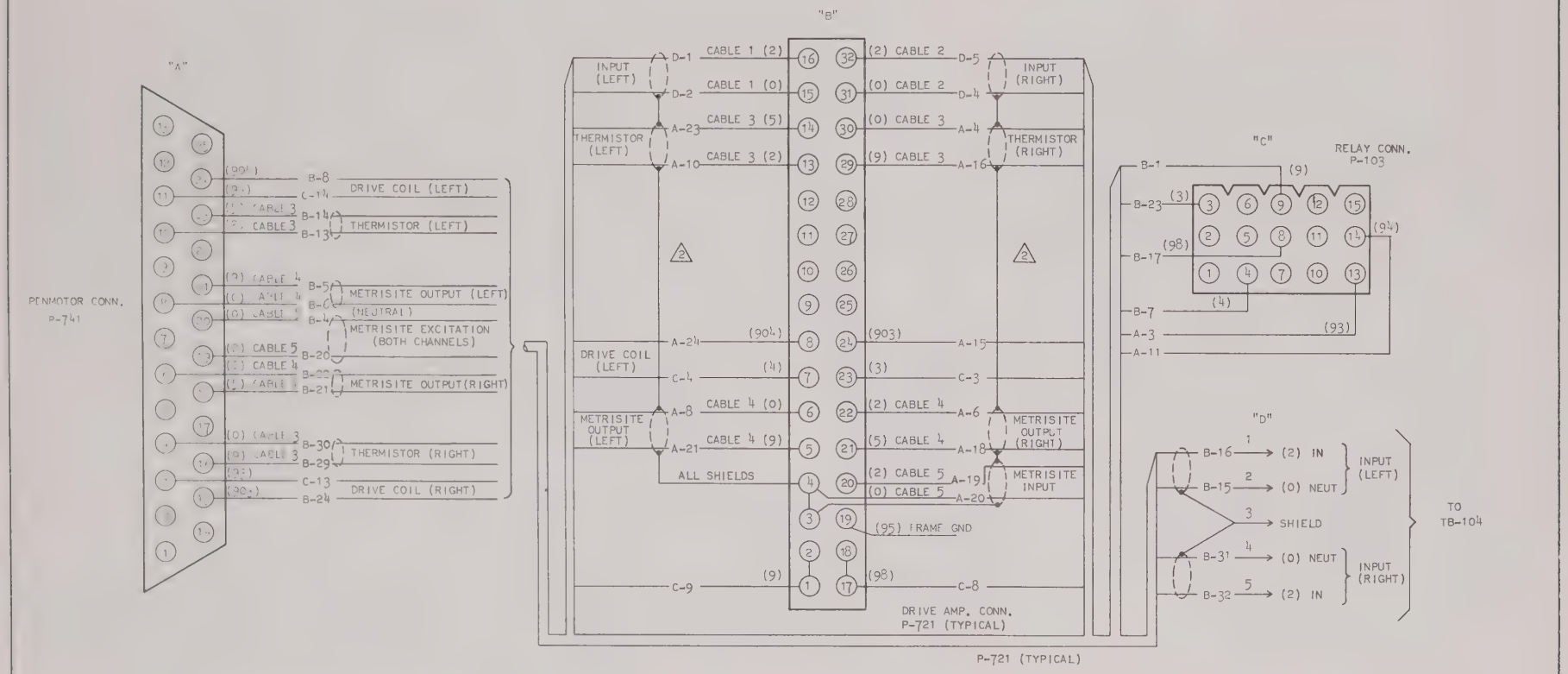


UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES = ± ½ .XX = ± .015 .XXX = ± .005 SURFACE = √ MATL. ADD FIN. FIRST USE	DR. BY Lowe 8/26/64 CH BY [illegible] DATE APPR. [illegible] 8-31-64	NAME SCHEMATIC MODEL NO.: 15-5221-21	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP CLEVELAND OHIO U S A	
		CODE IDENT. / ISSUE CODE G / SCALE / WT	DWG. NO 448145	

Information contained herein is considered proprietary to BRUSH electronics division of CLEVITE CORPORATION. Release of this information is to facilitate the servicing and maintenance of Brush equipment only.

Under no circumstances shall this information be transmitted, or produced, disclosed to, or used by any person or organization other than those engaged in such activities without the express written consent of BRUSH electronics division of CLEVITE CORPORATION.

REV. 00-1



NOTES:

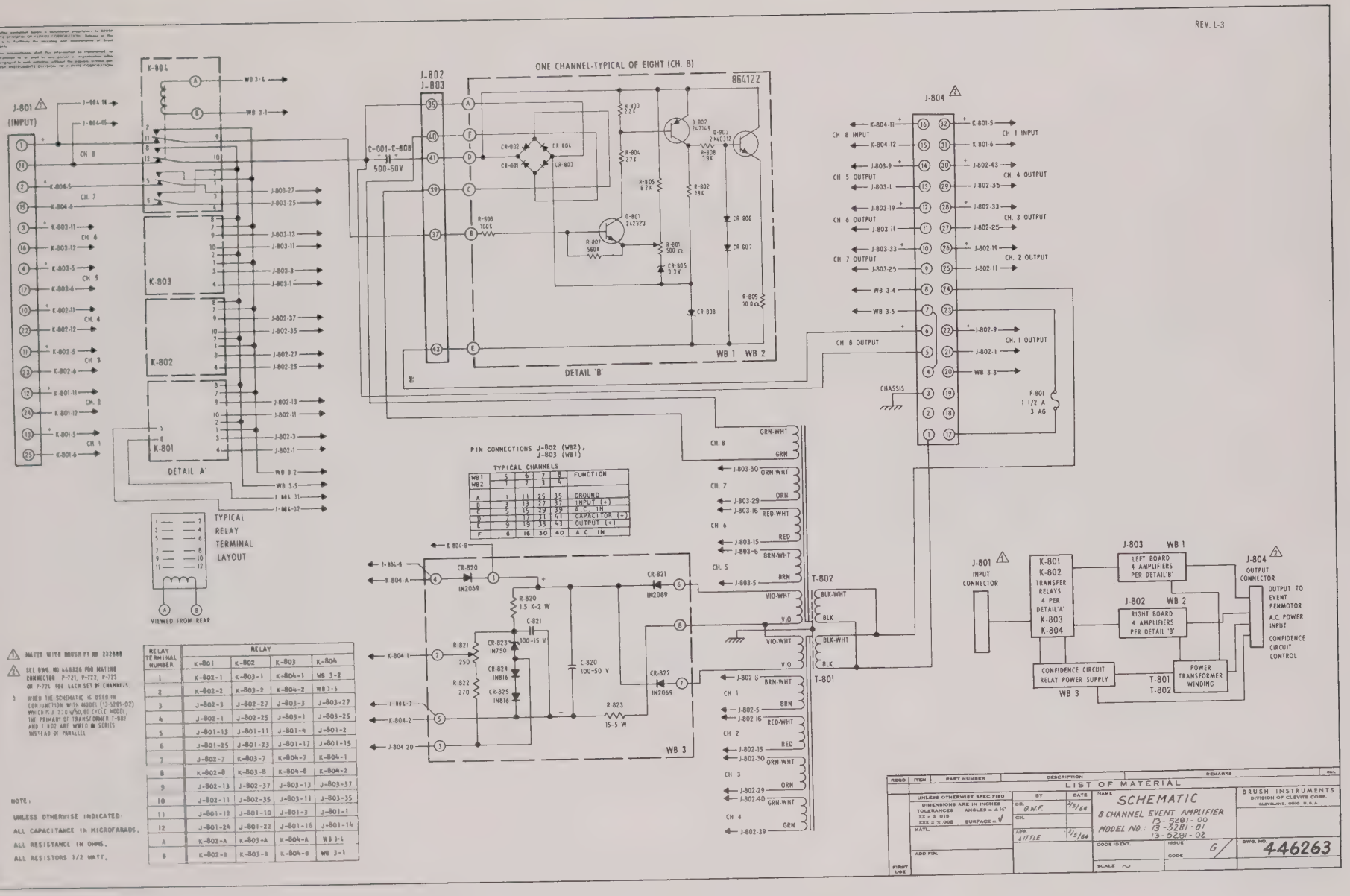
1. ALL WIRE NUMBERS AND DATA CODE ARE SHOWN IN PARENTHESES ( ).

2. JUMPERS SHOWN BETWEEN CABLE SHIELDS ARE PRODUCED BY DRAIN WIRES, NOT EXTERNAL CONNECTIONS.

3. ALL CONNECTORS VIEWED FROM WIRING SIDE.

BY	DATE	NAME	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND OHIO U.S.A.
DR Balch	6-21-65	DIAGRAM, WIRING MODEL NO. 11-2292-20	DWG. NO. 262090
CH. HBS	9/24/65	CODE IDENT	ISSUE CODE G
APP.			SHEET 1 OF 1

REV. L-3



⚠ MATES WITH BRUSH PT NO 232888

⚠ SEE DWG NO 446826 FOR MATING CONNECTOR P-721, P-722, P-723 OR P-724 FOR EACH SET OF CHANNELS.

3 WHEN THE SCHEMATIC IS USED IN CONJUNCTION WITH MODEL (13-5281-02) WHICH IS A 230 V/50, 60 CYCLE MODEL, THE PRIMARY OF TRANSFORMER T-801 AND T-802 ARE WIRED IN SERIES INSTEAD OF PARALLEL

RELAY TERMINAL NUMBER	RELAY K-801	K-802	K-803	K-804
1	K-802-1	K-803-1	K-804-1	WB 3-2
2	K-802-2	K-803-2	K-804-2	WB 3-3
3	J-802-3	J-802-27	J-803-3	J-803-27
4	J-802-1	J-802-25	J-803-1	J-803-25
5	J-801-13	J-801-11	J-801-4	J-801-2
6	J-801-25	J-801-23	J-801-17	J-801-15
7	J-802-7	K-803-7	K-804-7	K-804-1
8	K-802-8	K-803-8	K-804-8	K-804-2
9	J-802-13	J-802-37	J-803-13	J-803-37
10	J-802-11	J-802-35	J-803-11	J-803-35
11	J-801-12	J-801-10	J-801-3	J-801-1
12	J-801-24	J-801-22	J-801-16	J-801-14
A	K-802-A	K-803-A	K-804-A	WB 3-4
B	K-802-B	K-803-B	K-804-B	WB 3-1

NOTE:
UNLESS OTHERWISE INDICATED:
ALL CAPACITANCE IN MICROFARADS.
ALL RESISTANCE IN OHMS.
ALL RESISTORS 1/2 WATT.

REQD	ITEM	PART NUMBER	DESCRIPTION	REMARKS	CKL

LIST OF MATERIAL

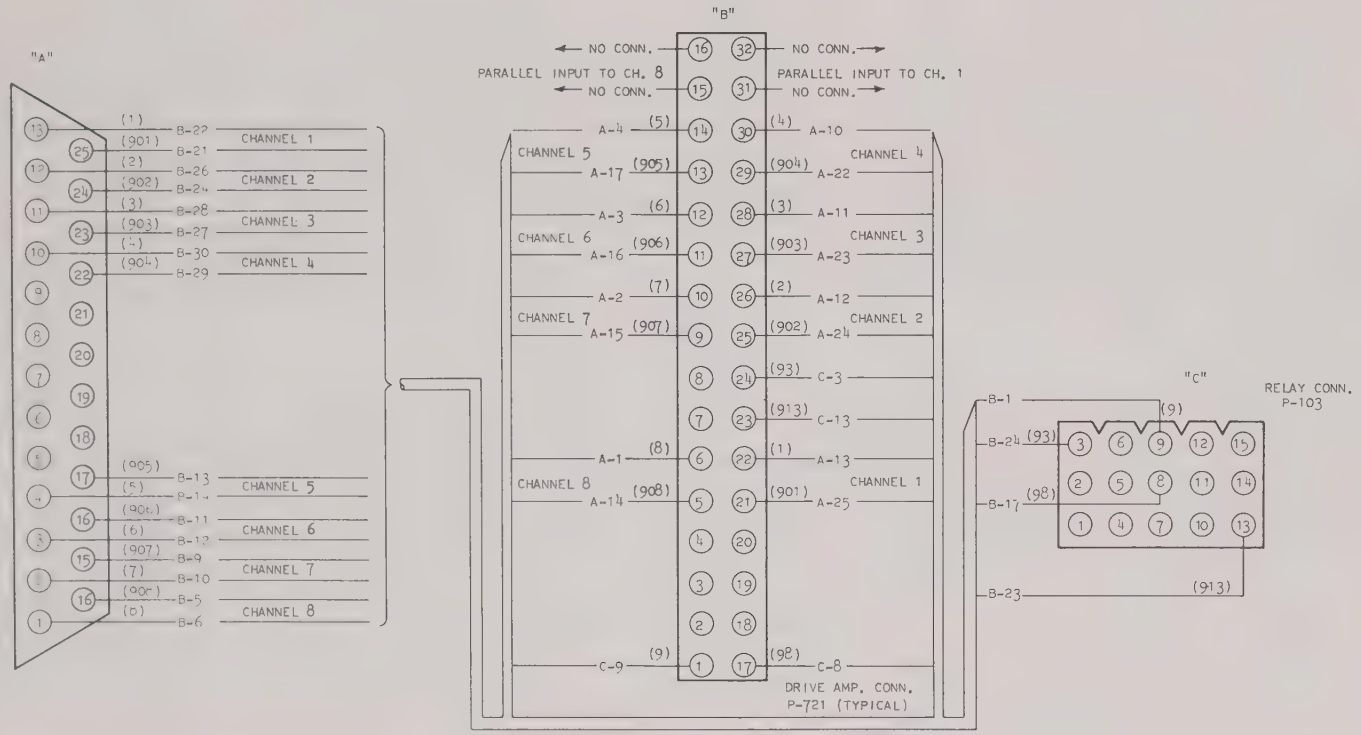
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ANGLES = ± 15'
.XX = ± .015
.XXX = ± .005
SURFACE = √
MATL.
ADD PIN.
FIRST USE

	BY	DATE
DR.	G.M.F.	2/3/64
CH.		
APP.	LITTLE	2/3/64

NAME: SCHEMATIC 8 CHANNEL EVENT AMPLIFIER
MODEL NO.: 13-5281-01 13-5281-02

BRUSH INSTRUMENTS
DIVISION OF CLEVITE CORP.
CLEVELAND, OHIO U.S.A.

CODE IDENT.
ISSUE G
CODE
SCALE ~
DWG. NO. 446263



2. ALL WIRE COLORS [illegible] CODE ARE SHOWN IN PARENTHESES.

1. ALL CONNECTORS VIEWED FROM WIRING SIDE.

NOTES:

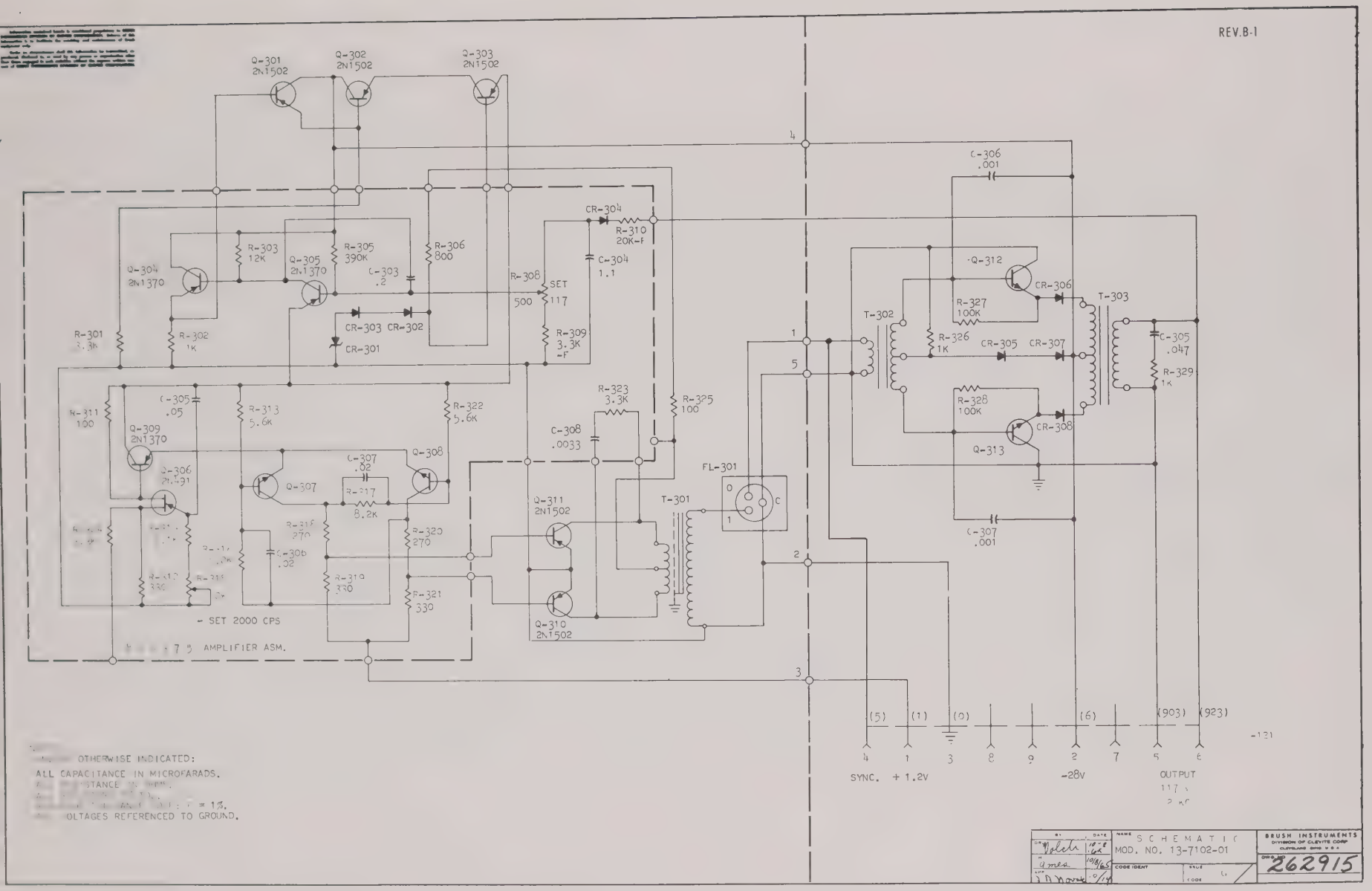
BY	DATE	NAME
DR		DIAGRAM, WIRING
CH		MODEL NO. 11-2298-20
APP		CODE IDENT / ISSUE CODE: G

BRUSH INSTRUMENTS
DIVISION OF CLEVITE CORP
CLEVELAND OHIO U.S.A.

DWG NO. 262003

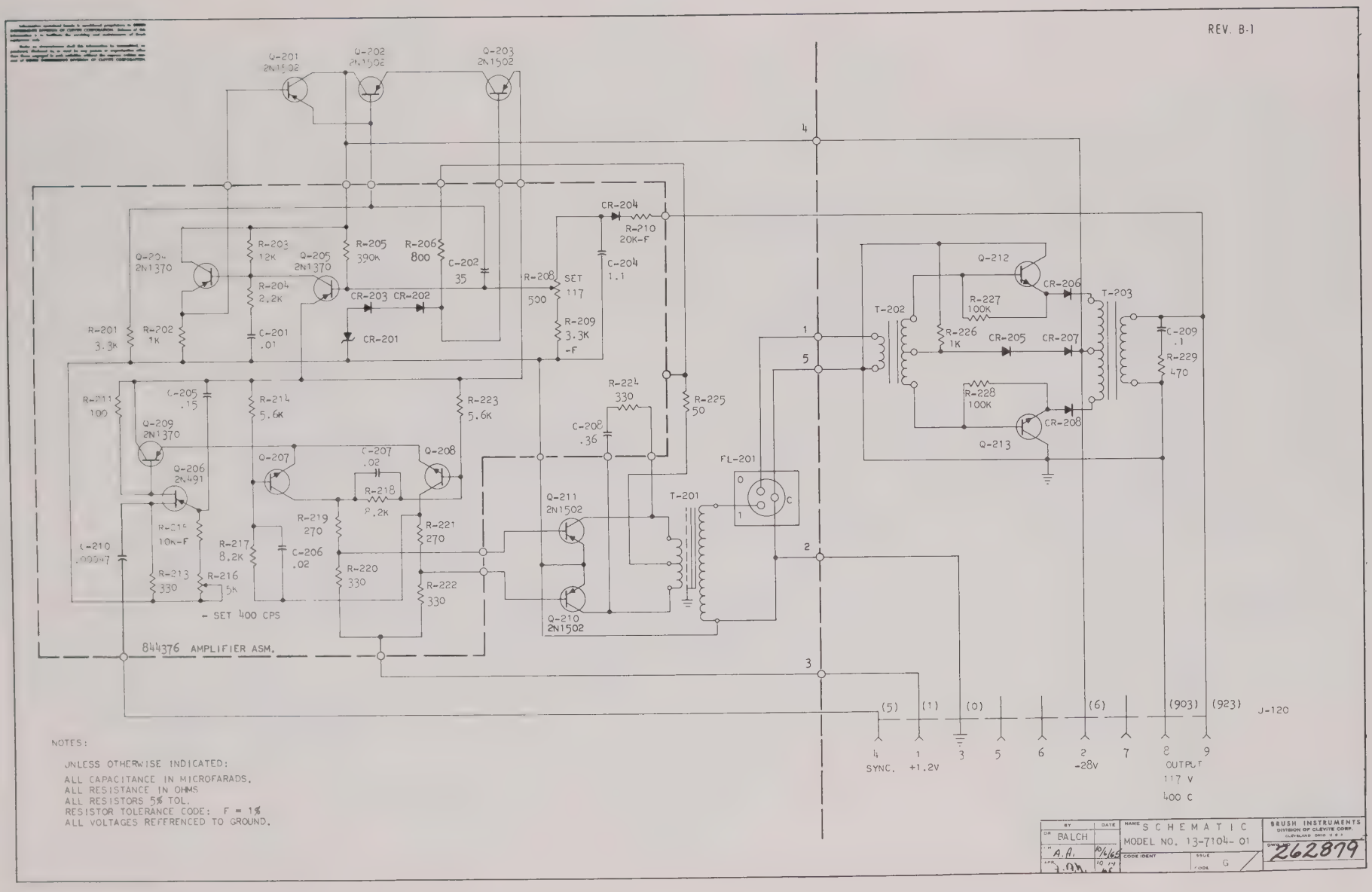
SHEET 1 OF 1

REV.B-1



OTHERWISE INDICATED:
ALL CAPACITANCE IN MICROFARADS.
= 1%.
OLTAGES REFERENCED TO GROUND.

		NAME SCHEMATIC	BRUSH INSTRUMENTS
		MOD. NO. 13-7102-01	ORDER NO. 262915
		CODE IDENT	SIZE CODE

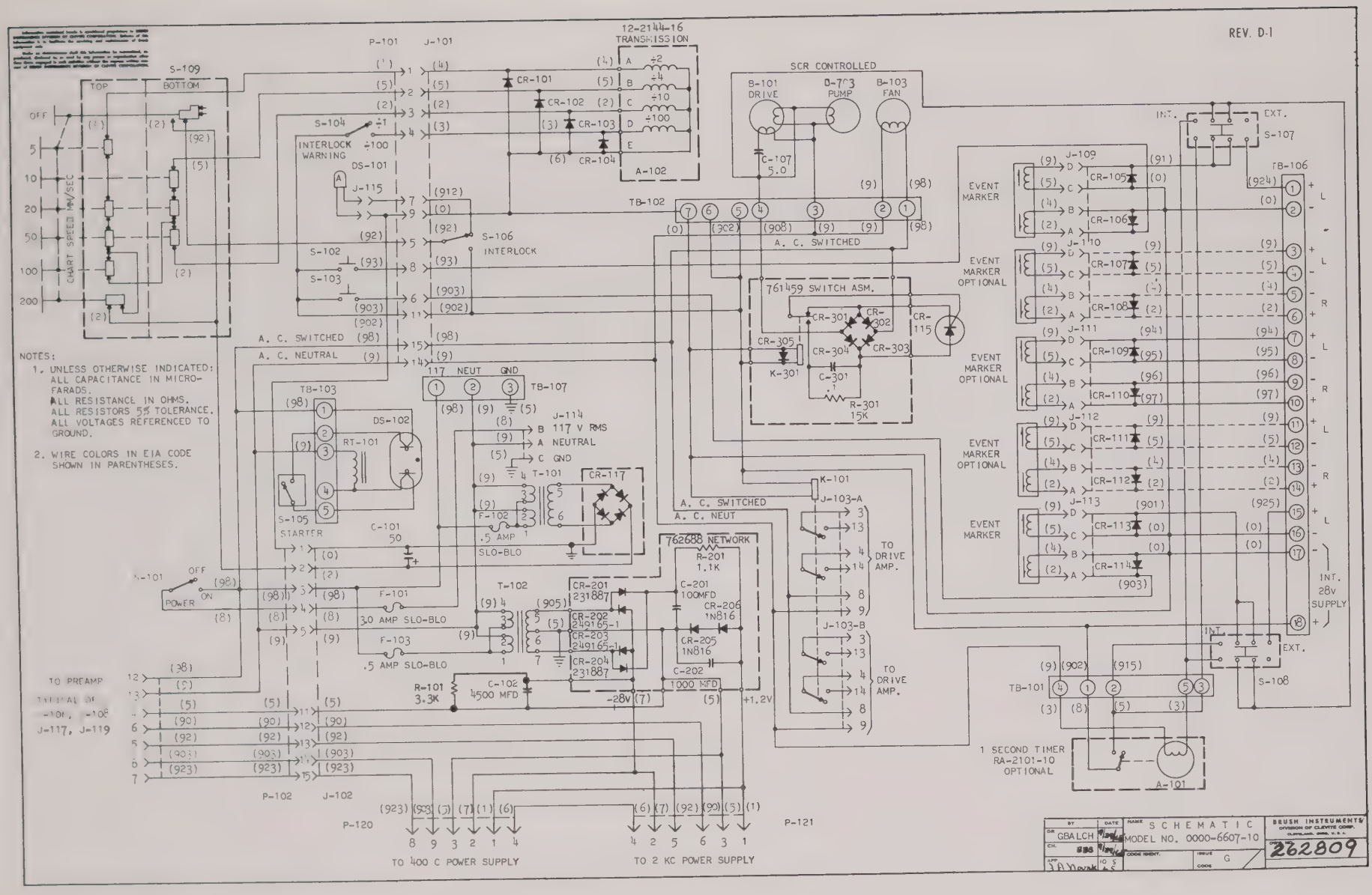


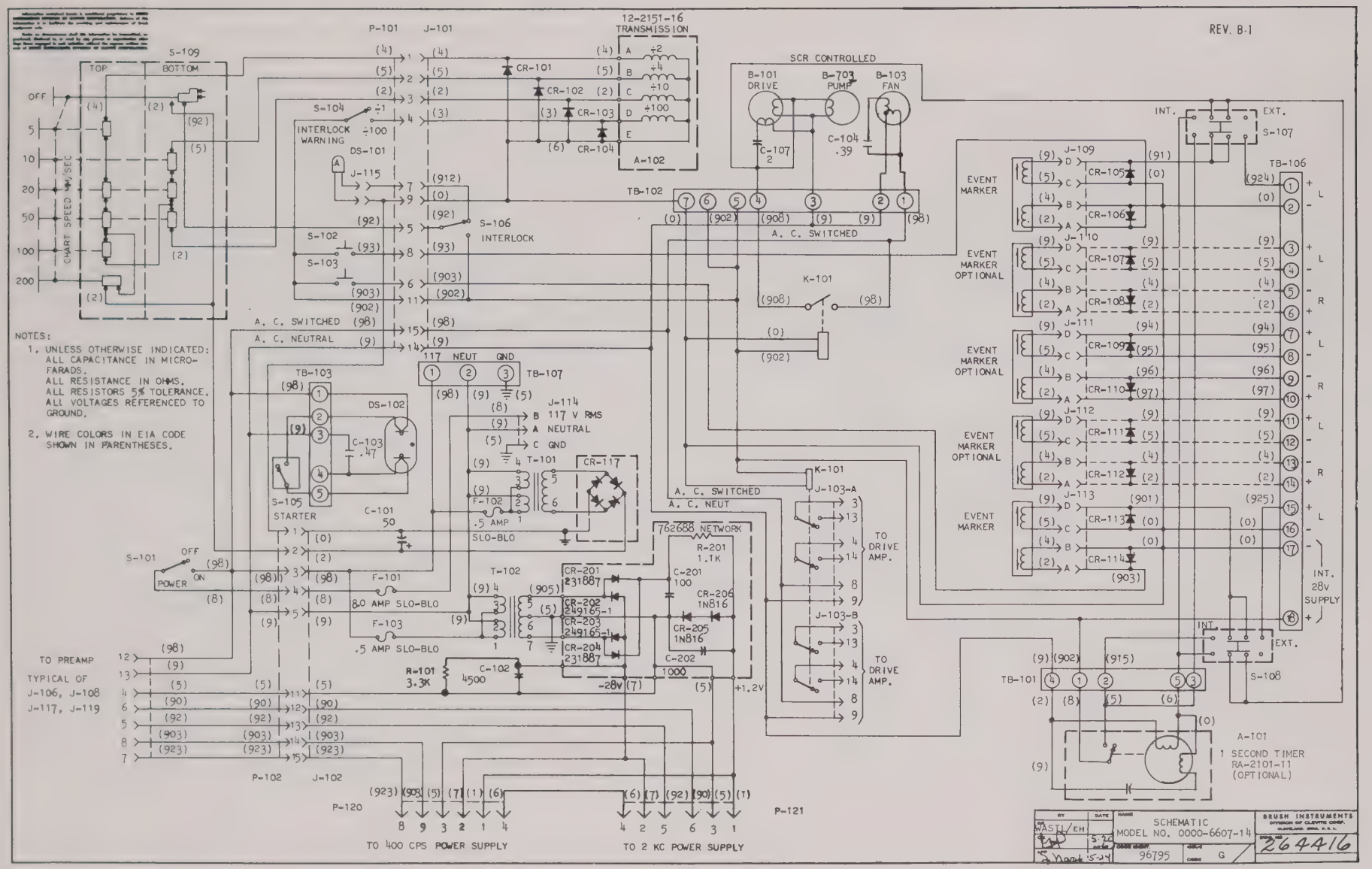
NOTES:

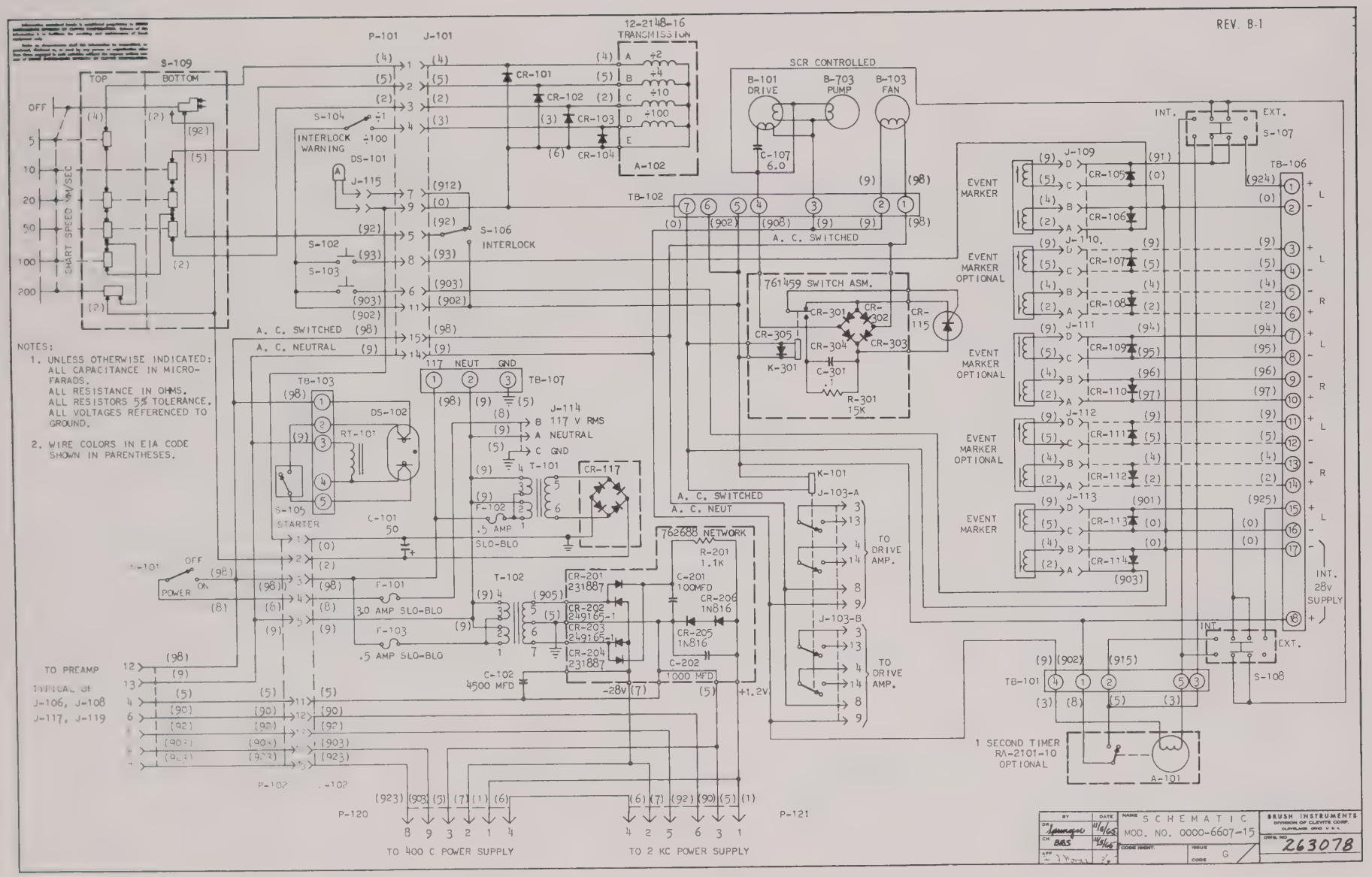
UNLESS OTHERWISE INDICATED:

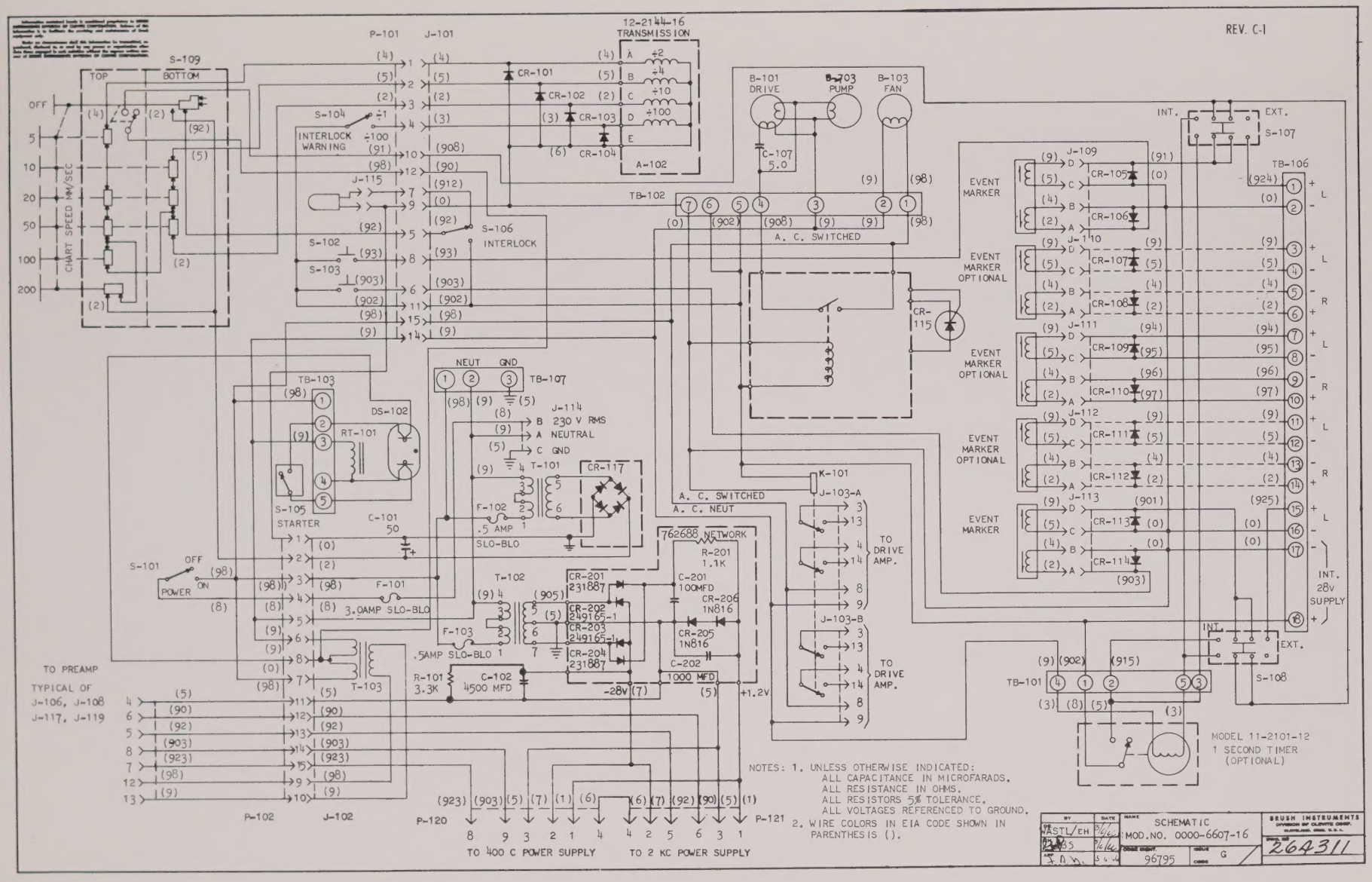
ALL CAPACITANCE IN MICROFARADS.
ALL RESISTANCE IN OHMS
ALL RESISTORS 5% TOL.
RESISTOR TOLERANCE CODE: F = 1%
ALL VOLTAGES REFFRENCED TO GROUND.

BY	DATE	NAME	SCHEMATIC	BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND OHIO U.S.A.
DR BALCH		MODEL NO. 13-7104-01		DWG NO. 262879
APP A.A.	10/4/65	CODE IDENT	ISSUE CODE G	


REV. D-1
12-21144-16 TRANSMISSION
P-101
J-101
S-109
TOP
BOTTOM
OFF
CHART SPEED MM/SEC
5
10
20
50
100
200
S-104
INTERLOCK WARNING
÷1
÷10
÷100
DS-101
J-115
S-102
S-103
S-106
INTERLOCK
CR-101
CR-102
CR-103
CR-104
A-102
A
B
C
D
E
÷2
÷4
÷10
÷100
SCR CONTROLLED
B-101 DRIVE
B-102 PUMP
B-103 FAN
C-107 5.0
TB-102
A. C. SWITCHED
A. C. NEUTRAL
117 NEUT GND
TB-107
TB-103
DS-102
RT-101
S-105
STARTER
J-114
117 V RMS
NEUTRAL
GND
T-101
CR-117
F-102
.5 AMP
SLO-BLO
C-101
50
S-101
OFF
ON
POWER
F-101
3.0 AMP SLO-BLO
F-103
.5 AMP SLO-BLO
T-102
CR-201 231887
CR-202 249165-1
CR-203 249165-1
CR-204 231887
762688 NETWORK
R-201 1.1K
C-201 100MFD
CR-206 1N816
CR-205 1N816
C-202 1000 MFD
R-101 3.3K
C-102 4500 MFD
-28v
+1.2V
761459 SWITCH ASM.
CR-301
CR-302
CR-303
CR-304
CR-305
CR-115
K-301
C-301
R-301 15K
K-101
J-103-A
J-103-B
TO DRIVE AMP.
TO DRIVE AMP.
EVENT MARKER
EVENT MARKER OPTIONAL
EVENT MARKER OPTIONAL
EVENT MARKER OPTIONAL
EVENT MARKER
J-109
J-110
J-111
J-112
J-113
CR-105
CR-106
CR-107
CR-108
CR-109
CR-110
CR-111
CR-112
CR-113
CR-114
INT.
EXT.
S-107
TB-106
INT. 28v SUPPLY
S-108
TB-101
1 SECOND TIMER RA-2101-10 OPTIONAL
A-101
NOTES:
1. UNLESS OTHERWISE INDICATED: ALL CAPACITANCE IN MICRO-FARADS. ALL RESISTANCE IN OHMS. ALL RESISTORS 5% TOLERANCE. ALL VOLTAGES REFERENCED TO GROUND.
2. WIRE COLORS IN EIA CODE SHOWN IN PARENTHESES.
TO PREAMP TERMINAL OF J-101, J-108 J-117, J-119
P-102
J-102
P-120
P-121
TO 400 C POWER SUPPLY
TO 2 KC POWER SUPPLY
SCHEMATIC
MODEL NO. 0000-6607-10
BRUSH INSTRUMENTS
DIVISION OF CLEVITE CORP.
CLEVELAND, OHIO, U.S.A.
DRAWING NO. 262809
GBALCH
ISSUE G


REV. B-1
S-109
TOP
BOTTOM
OFF
5
10
20
50
100
200
CHART SPEED MM/SEC
P-101
J-101
12-2151-16
TRANSMISSION
A-102
CR-101
CR-102
CR-103
CR-104
S-104
INTERLOCK WARNING
DS-101
J-115
S-102
S-103
S-106
INTERLOCK
A. C. SWITCHED
A. C. NEUTRAL
SCR CONTROLLED
B-101 DRIVE
B-703 PUMP
B-103 FAN
C-107 2
C-104 .39
TB-102
A. C. SWITCHED
K-101
EVENT MARKER
EVENT MARKER OPTIONAL
J-109
J-110
J-111
J-112
J-113
CR-105
CR-106
CR-107
CR-108
CR-109
CR-110
CR-111
CR-112
CR-113
CR-114
INT.
EXT.
S-107
TB-106
INT. 28v SUPPLY
TB-103
DS-102
C-103 .47
S-105
STARTER
C-101 50
TB-107
117 NEUT GND
J-114
117 V RMS
NEUTRAL
GND
T-101
CR-117
F-102 .5 AMP SLO-BLO
762688 NETWORK
R-201 1.1K
C-201 100
CR-206 1N816
CR-205 1N816
C-202 1000
CR-201 231887
CR-202 249165-1
CR-203 249165-1
CR-204 231887
T-102
S-101
OFF
ON
POWER
F-101 8.0 AMP SLO-BLO
F-103 .5 AMP SLO-BLO
R-101 3.3K
C-102 4500
-28v
+1.2v
K-101
J-103-A
J-103-B
TO DRIVE AMP.
TO DRIVE AMP.
TB-101
S-108
A-101
1 SECOND TIMER RA-2101-11 (OPTIONAL)
TO PREAMP
TYPICAL OF J-106, J-108 J-117, J-119
P-102
J-102
P-120
P-121
TO 400 CPS POWER SUPPLY
TO 2 KC POWER SUPPLY
NOTES:
1. UNLESS OTHERWISE INDICATED: ALL CAPACITANCE IN MICRO-FARADS. ALL RESISTANCE IN OHMS. ALL RESISTORS 5% TOLERANCE. ALL VOLTAGES REFERENCED TO GROUND.
2. WIRE COLORS IN EIA CODE SHOWN IN PARENTHESES.
WASTI/EH
SCHEMATIC
MODEL NO. 0000-6607-14
BRUSH INSTRUMENTS
96795
G
264416


REV. B-1
S-109
TOP
BOTTOM
OFF
5
10
20
50
100
200
CHART SPEED MM/SEC
P-101
J-101
12-2148-16
TRANSMISSION
A-102
CR-101
CR-102
CR-103
CR-104
S-104
INTERLOCK WARNING
DS-101
J-115
S-102
S-103
S-106
INTERLOCK
SCR CONTROLLED
B-101 DRIVE
B-703 PUMP
B-103 FAN
C-107 6.0
TB-102
A. C. SWITCHED
A. C. NEUTRAL
761459 SWITCH ASM.
CR-301
CR-302
CR-303
CR-304
CR-305
CR-115
K-301
C-301
R-301 15K
EVENT MARKER
EVENT MARKER OPTIONAL
J-109
J-110
J-111
J-112
J-113
CR-105
CR-106
CR-107
CR-108
CR-109
CR-110
CR-111
CR-112
CR-113
CR-114
INT.
EXT.
S-107
TB-106
INT. 28v SUPPLY
S-108
TB-101
TB-103
TB-107
117 NEUT GND
J-114
117 V RMS
A NEUTRAL
C GND
DS-102
RT-101
S-105
STARTER
C-101
50
T-101
CR-117
F-102
.5 AMP SLO-BLO
T-102
F-101
3.0 AMP SLO-BLO
F-103
.5 AMP SLO-BLO
762688 NETWORK
R-201 1.1K
C-201 100MFD
CR-201 231887
CR-202 2N916S-1
CR-203 2N916S-1
CR-204 231887
CR-206 1N816
CR-205 1N816
C-202 1000 MFD
C-102 4500 MFD
-28V
+1.2V
K-101
J-103-A
J-103-B
TO DRIVE AMP.
TO PREAMP
TYPICAL OF J-106, J-108 J-117, J-119
P-102
P-120
P-121
TO 400 C POWER SUPPLY
TO 2 KC POWER SUPPLY
1 SECOND TIMER RA-2101-10 OPTIONAL
A-101
NOTES:
1. UNLESS OTHERWISE INDICATED: ALL CAPACITANCE IN MICROFARADS. ALL RESISTANCE IN OHMS. ALL RESISTORS 5% TOLERANCE. ALL VOLTAGES REFERENCED TO GROUND.
2. WIRE COLORS IN EIA CODE SHOWN IN PARENTHESES.
BY
DR Youngquist
CH BAS
APP
DATE
11/6/65
4/5/66
NAME SCHEMATIC
MOD. NO. 0000-6607-15
CODE IDENT.
ISSUE CODE G
BRUSH INSTRUMENTS
DIVISION OF CLEVITE CORP.
CLEVELAND OHIO U.S.A.
DWG. NO. 263078


REV. C-1
12-2144-16 TRANSMISSION
P-101 J-101
S-109
TOP BOTTOM
OFF
CHART SPEED MM/SEC
5
10
20
50
100
200
S-104 ÷1 ÷100
INTERLOCK WARNING
J-115
S-102
S-103
S-106 INTERLOCK
CR-101
CR-102
CR-103
CR-104
A-102
÷2
÷4
÷10
÷100
B-101 DRIVE
B-703 PUMP
B-103 FAN
C-107 5.0
TB-102
A. C. SWITCHED
EVENT MARKER
EVENT MARKER OPTIONAL
EVENT MARKER OPTIONAL
EVENT MARKER OPTIONAL
EVENT MARKER
CR-115
INT.
EXT.
S-107
TB-106
J-109
J-110
J-111
J-112
J-113
CR-105
CR-106
CR-107
CR-108
CR-109
CR-110
CR-111
CR-112
CR-113
CR-114
L
R
INT. 28v SUPPLY
TB-103
DS-102
RT-101
S-105 STARTER
C-101 50
NEUT GND
TB-107
J-114
B 230 V RMS
A NEUTRAL
C GND
T-101
CR-117
F-102 .5 AMP SLO-BLO
K-101
A. C. SWITCHED
A. C. NEUT
J-103-A
J-103-B
TO DRIVE AMP.
762688 NETWORK
R-201 1.1K
C-201 100MFD
CR-206 1N816
CR-205 1N816
C-202 1000 MFD
S-101 OFF POWER ON
F-101 3.0AMP SLO-BLO
T-102
CR-201 231887
CR-202 249165-1
CR-203 249165-1
CR-204 231887
F-103 .5AMP SLO-BLO
R-101 3.3K
C-102 4500 MFD
-28V
+1.2V
T-103
TB-101
S-108
MODEL 11-2101-12 1 SECOND TIMER (OPTIONAL)
TO PREAMP TYPICAL OF J-106, J-108 J-117, J-119
P-102 J-102
P-120
P-121
TO 400 C POWER SUPPLY
TO 2 KC POWER SUPPLY
NOTES: 1. UNLESS OTHERWISE INDICATED:
ALL CAPACITANCE IN MICROFARADS.
ALL RESISTANCE IN OHMS.
ALL RESISTORS 5% TOLERANCE.
ALL VOLTAGES REFERENCED TO GROUND.
2. WIRE COLORS IN EIA CODE SHOWN IN PARENTHESIS ().
BY WASTL/EH
DATE 5/6/64
NAME SCHEMATIC
MOD.NO. 0000-6607-16
BRUSH INSTRUMENTS
DIVISION OF CLEVITE CORP.
CLEVELAND, OHIO, U.S.A.
CAGE NO. 96795
ISSUE G
SIZE D
DWG NO. 264311

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